DISSERTATION

on

ANEMIA IN AGEING POPULATION – A STUDY OF PREVALENCE AND CAUSES

Submitted in partial fulfillment of

MD DEGREE EXAMINATION

BRANCH-XVI GERIATRIC MEDICINE

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY CHENNAI

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CERTIFICATE

This is to certify that the dissertation titled **"ANEMIA OF AGEING POPULATION –A STUDY OF PREVALENCE AND CAUSES"** a bonafide work done by **Dr. D. PRIYAMALINI**, Post Graduate Student, Department of Geriatric Medicine, Madras Medical College, Chennai – 600003, in partial fulfillment of the university rules and regulations for the award of MD DEGREE in GERIATRIC MEDICINE BRANCH-XVI, under our guidance and supervision, during the academic period from April 2010 to April 2013.

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DECLARATION

I solemnly declare that the dissertation titled **" ANEMIA IN AGEING POPULATION – A STUDY OF PREVALENCE AND CAUSES "** was done by me at Madras Medical College , Chennai -03 during the period June 2012 to December 2012 under the guidance of **Prof. B. KRISHNASWAMY, MD,** to be submitted to The Tamil Nadu Dr. M.G.R. Medical University towards the partial fulfillment of requirements for the award of MD DEGREE in GERIATRIC MEDICINE BRANCH-XVI.

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INTRODUCTION

Population ageing is occurring worldwide and it is more so in developing countries like India. There is a double burden with the ageing population on one end and the existing older persons are getting older as well. Keeping this demographic reality, characterization of health conditions that have impact on the functional as well as the survival in older age population is necessary.

Anemia is one of the commonest disease that has adverse outcome in older population including hospitalisation, disability and mortality. Since anemia is a multi-factorial condition, it is difficult to establish whether anemia is a marker of disease burden or a mediator in casual pathway leading to adverse impacts. Varying degrees of anemia may be present in the elderly patient. It may be common, but it should not be accepted as normal aging.

Poorer outcomes associated with anemic elders, and the mortality rate is increased in these patients. As the geriatric population grows, the incidence of anemia and its complications in this population will become a significant healthcare burden.

Geriatric patients may have psychological, sociological, and physical changes resulting from aging that complicate treatment. Careful oversight will help to prevent redundant tests or treatments and thus reduces polypharmacy.

In 2000, global ageing population was 600 million and this tends to double in 2025 and triple by 2050. A recent study on Prevalence of Anemia by National Health And Nutrition Examination Survey (NHANES lll) showed the following indices:

- Older men – 11% prevalence
- Older women – 10.2%
- Overall community dwelling (> 65 years) – 10.6%

As age progresses prevalence of anemia steadily increase and found to be highest in age group > 85 years. Significant differences were also perceived with respect to race and ethnicity and both sexes.

- 65-75 years: women > men
- 75-85 years: men > women
- >85 years: men > women

Prevalence was the lowest in non Hispanic whites and in the Non-Hispanic blacks. Identifying anemia as an important aspect of comprehensive geriatric assessment is essential. Identifying the type of anemia goes a long way in improving the overall outcome of the elderly and their quality of life.

AIM OF STUDY

1. To assess the different types of anemia in elderly patients.

2. To Assess the nutritional status of the patient and to correlate with the type Anemia

3. To assess anemia of chronic illness

4. To assess the prevalence of Myelo Dysplastic Syndrome in Indian elderly.

REVIEW OF LITERATURE

DEMOGRAPHY

Prevalence of anemia in elderly according to western reports is 8 – 44%. Significant percentage of anemia occurs in Nursing home residents , hospital in-patients followed by community dwellers.[1] [7] [23]

Elderly population in India is rising exponentially. The elder population which was around 1 crore in 1901 has become 8 crore in 2010. According to 2010 census their population is about 8% percentage of the total population in India. The Indian aged population is the second largest in the world.

Most of the elderly are dependent both physically and financially. The health status of the elder population makes them more dependent. Older people present with atypical symptoms for common ailments.[3] [4] Hence the diagnosis becomes difficult and delayed. This sets in multiple other co- morbidities leading to functional decline.

PATHOGENESIS OF ANEMIA IN ELDERLY

Debate is still on whether anemia in elderly has a specific underlying cause as in other age groups or is purely a decline of marrow function- a process seen in ageing. [11]

Hemopoietic changes in marrow due to ageing shows decreased number of committed stem cells and increase in fat.[18] Inaddition to these changes, anemia is found to be a result of blunted response to hemopoietic stress such as malnutrition, chronic inflammatory disease, chronic kidney disease and iron deficiency.

Nutritional deficiency is reported to be not common in elderly in western countries as in young, mainly because of iron stores which have cumulatively built up in tissues. Predictors of nutritional status like serum albumin, transferrin and pre-albumin were also found to be good predictors of anemia.

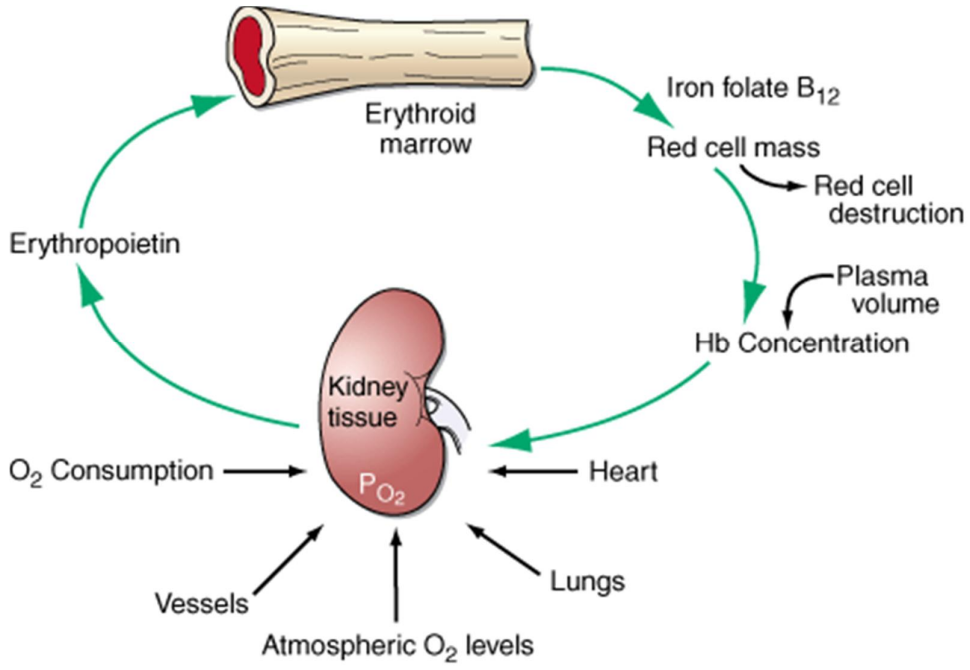
Alteration in hemopoietic function in ageing was found to be similar to protein energy malnutrition. A low BMI is also associated with high risk of mortality in ageing.

BIOLOGY OF HEMOTOPOIESIS

Hematopoietic system arises from a small pool of hematopoietic stem cells which either differentiates into mature leukocytes, erythrocytes or platelets or self renews itself.[18] HSC's differentiation occurs through committed progenitor and precursors. Haematopoiesis is regulated by complex interactions between HSC's, stromal micro environment and hematopoietic growth factors. Hence a strict balance is needed to

maintain self- renewal differentiation, maturation and cell loss. In the bone marrow, the first morphologically recognizable erythroid precursor is the pronormoblast. This cell can undergo 4–5 cell divisions that result in the production of 16–32 mature red cells. With increased EPO production, or the administration of EPO as a drug, early progenitor cell numbers are amplified and, in turn, give rise to increased numbers of erythrocytes. The regulation of EPO production itself is linked to O_2 availability.

In mammals, O_2 is transported to tissues bound to the hemoglobin contained within circulating red cells. The mature red cell is 8 microns in diameter, anucleate, discoid in shape, and extremely pliable in order to



traverse the microcirculation successfully; its membrane integrity is maintained by the intracellular generation of ATP. Normal red cell

production results in the daily replacement of 0.8–1% of all circulating red cells in the body, since the average red cell lives 100–120 days. The organ responsible for red cell production is called the erythron. The erythron is a dynamic organ made up of a rapidly proliferating pool of marrow erythroid precursor cells and a large mass of mature circulating red blood cells. The size of the red cell mass reflects the balance of red cell production and destruction. The physiologic basis of red cell production and destruction provides an understanding of the mechanisms that can lead to anemia.

EFFECTS OF AGEING ON HEMATOPOIESIS AND BONE MARROW FUNCTION

- In ageing replicative capacity of hemopoietic stem cells decreases and the ability of hemopoietic system to respond to stress decreases.[11]
- The RBC survival is unchanged and the plasma iron turn over remains unchanged. Red cell mass is normal and there is no obvious change in basal hemopoiesis with ageing.

The suboptimal response of hemopoietic system in stimulus driven situation and failure to maintain hemostasis is characteristic of ageing hemopoietic system. This blunted response is due to multiple factors like

age related defects in marrow progenitor cells, changes in marrow micro environment, decreased production of regulatory growth factors.

Predictors of nutritional status like serum albumin, serum transferrin and pre- albumin were also found to be good predictors of anaemia. Since these parameters determine the status of the elderly their measure is important in any case of nutritional survey.

An alteration of hemopoietic function in ageing is similar to protein energy malnutrition. A low BMI is also associated with high risk of mortality in ageing.

EFFECTS OF ANEMIA IN ELDERLY

Recent investigations have shown that anemia accounts for significant morbidity and mortality in elderly patients and can lead to cardiovascular and neurological manifestations like congestive cardiac failure, impaired cognitive functions, falls and functional impairment.[13] [37]

Anemia in geriatric population has been associated with increased frailty, decreased cognitive function, poor exercise performance, decreased mobility, increased chances for dementia, increased risk of falls and increased rates of depression.[31][36][38][40]

Studies have shown that presence of both anemia and other co-morbidities are associated with increased risk of adverse outcomes.[15][21][30]

Anemia has a major impact on cardio vascular system in elderly and both these risk factors leads to frailty.[28] A hospital based study showed an association between anemia and impairment of executive function.[39]

Mortality:

Anemia which primarily constitute the WHO defined anemia, is an independent risk factor for 5 year all-cause mortality. Mortality risk also increases with increase in severity of anemia.[13][25] Also the interaction of anemia with other co-morbidities including chronic kidney disease, left ventricular hypertrophy and chronic vascular disease increases the mortality risk in older patients.

Decline in physical function:

Anemia is related to decline in physical function as well as physical disability.[15][25] Low normal haemoglobin levels were associated with increased likelihood of morbidity and disability. Anemia is associated with reduced aerobic capacity, increased fatigueness and difficulty in carrying out basic activities of daily living.[35]

Frailty status:

Frailty is defined as presence of 3 out of the 5 manifestations, including shrinkage, slowness, weakness, exhaustion and low energy expenditure. Anemia is one risk factor causative of frailty.[35]

WHO - Definition of anemia

Anemia is defined by WHO criteria which was established in 1986, as Hemoglobin concentration of <13g/dl in men and <12g/dl in women.

The difference in values of Hemoglobin in gender is because of differences in the distribution of Hemoglobin in older men and women. Conceptually anemia is a clinical syndrome caused by reduced mass of circulatory RBC.

Practically anemia is defined as decreased level of the following parameters

- Concentration of Hb in the whole blood.
- Hematocrit(Hct).
- Number of RBCs in standardised volume of whole blood.

Hemoglobin is expressed in g/dl, Hematocrit as % and RBC count as number of RBCs in million per micro-litre.

CLASSIFICATION OF ANEMIA

Morphological classification of anemia

On the basis of MCV, MCH, MCHC three main types of anemia are recognized.

1. Hypochromic microcytic anemia:
    a. The MCV is subnormal <80 fl
    b. MCH< 27 pg
    c. MCHC< 30g/dl

    Most important examples are iron deficiency in which there is inadequate iron for the formation of the heme component of haemoglobin and thalassemia, in which the formation of the globin component of the haemoglobin is defective.

2. Macrocytic anemia
    a. MCV is above >96 fl
    b. Megaloblastosis of bone marrow
    c. Due to B12 or folatedeficiency

3. Normochromic normocytic anemia:
    a. MCV, MCH, MCHC are within normal limits
    b. Loss of substantial amount of blood

c. Haemolysis

d. Bone marrow failure

e. Chronic renal failure

f. Chronic inflammation or infection

Basic Pathophysiological Categories of Anemia

A. Impaired red cell production

a. Decreased nutrient supply

i. Iron deficiency

ii. Vitamin B12 deficiency

iii. Folic acid deficiency

iv. Protein calorie malnutrition

b. Decreased erythropoetic activity

i. Infection

ii. Connective tissue disorders

iii. Inflammatory disorders

iv. Disseminated malignancy

v. Associated with renal failure

vi. Aplastic anemia

B. Anemia due to replacement of normal bone marrow

a) Leukemia

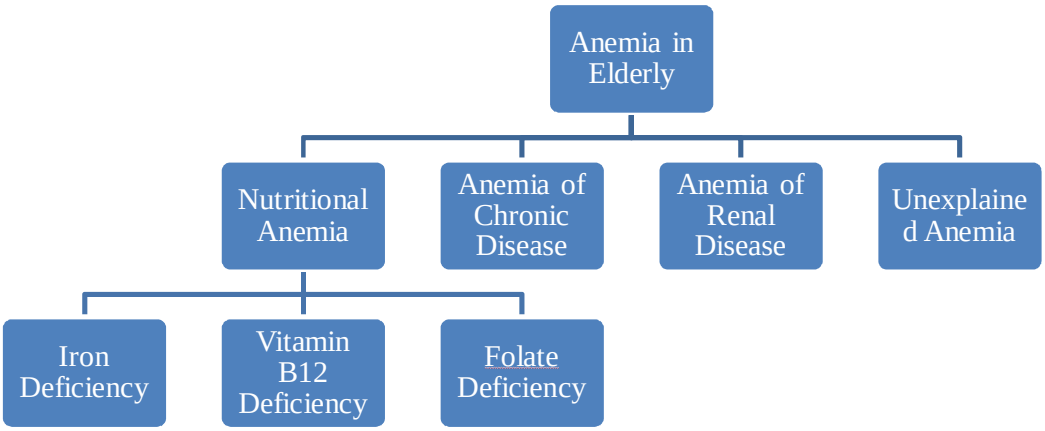
b) Lymphoma

c) Myelodysplastic abnormalities

d) Myeloproliferative disorders

e) Myeloma

Clinical Classification of Anemia in elderly



SYMPTOMS AND SIGNS OF ANEMIA

1. Easy fatigability
2. Irritability
3. Weakness
4. Breathlessness
5. Pale lips and skin
6. Brittle concave nails

7. Frontal headache
8. Sore tongue
9. Orthostatic hypotension
10. Tachycardia

INVESTIGATIONS DONE FOR A CASE OF ANEMIA

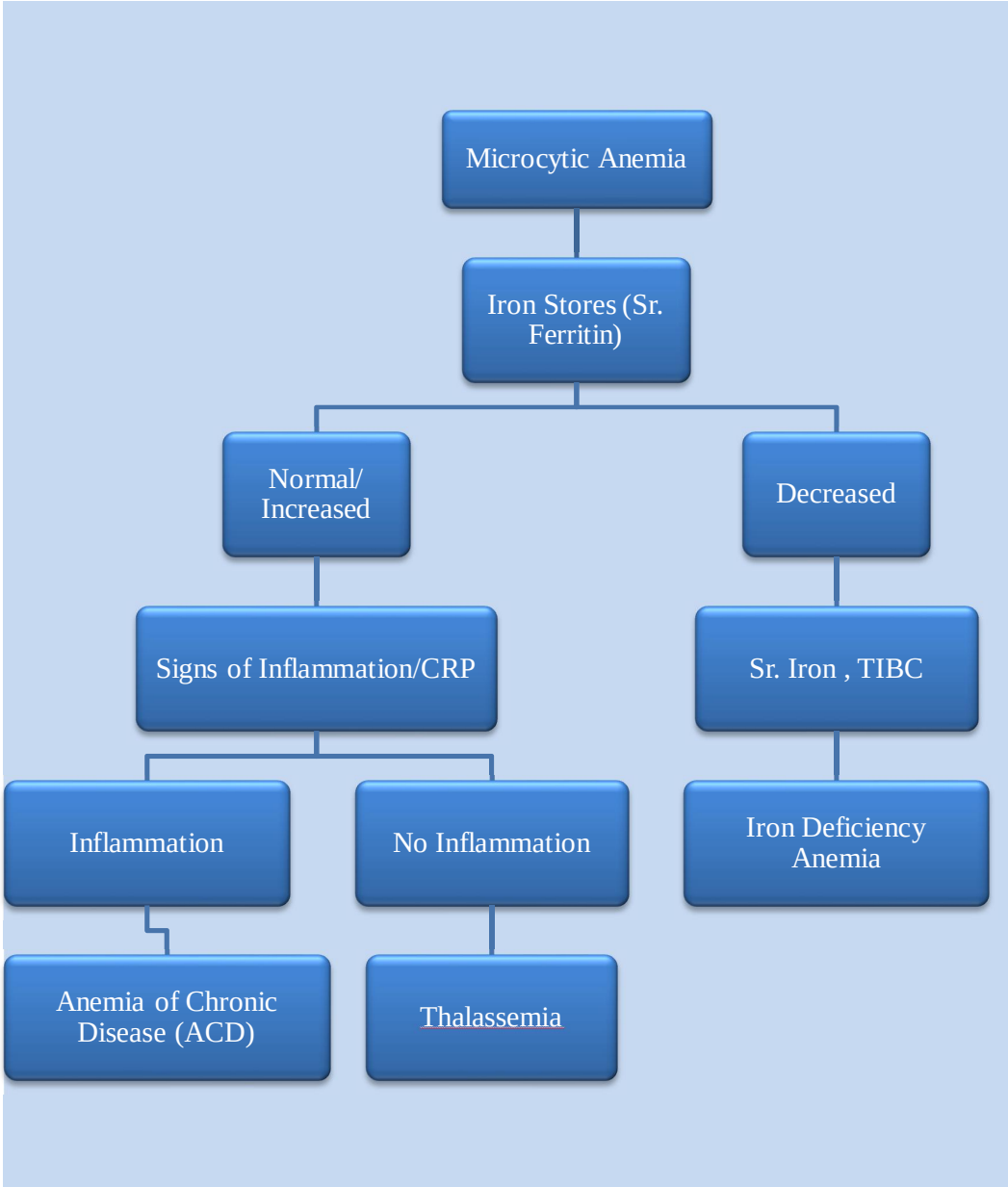
Tests that are commonly used in the preliminary assessment of anemia includes complete assessment of blood count and a number a key parameters including RBC count, WBC count, Hb concentration, hematocrit, mean corpuscular hemoglobin concentration, RDW, platelet count. Other additional tests include serum iron, serum ferritin, transferrin saturation are done for iron deficiency anemia.

To assess Vitamin B12 deficiency test such as serum Vitamin B12, serum methylmalonic acid, serum homocysteine are done. Measurement of methylmalonic acid and total homocysteine is a more sensitive test to assess Vitamin B12 deficiency because these levels elevate before serum Vitamin B12 falls. Tests to assess Folate deficiency include serum Folate and RBC Folate. GFR is calculated to assess renal function. For evaluation of hemolysis serum lactate dehydrogenase, indirect bilirubin concentration, serum haptoglobin concentration is measured. To evaluate occult GI bleeding, fecal occult blood detection is done and endoscopy of

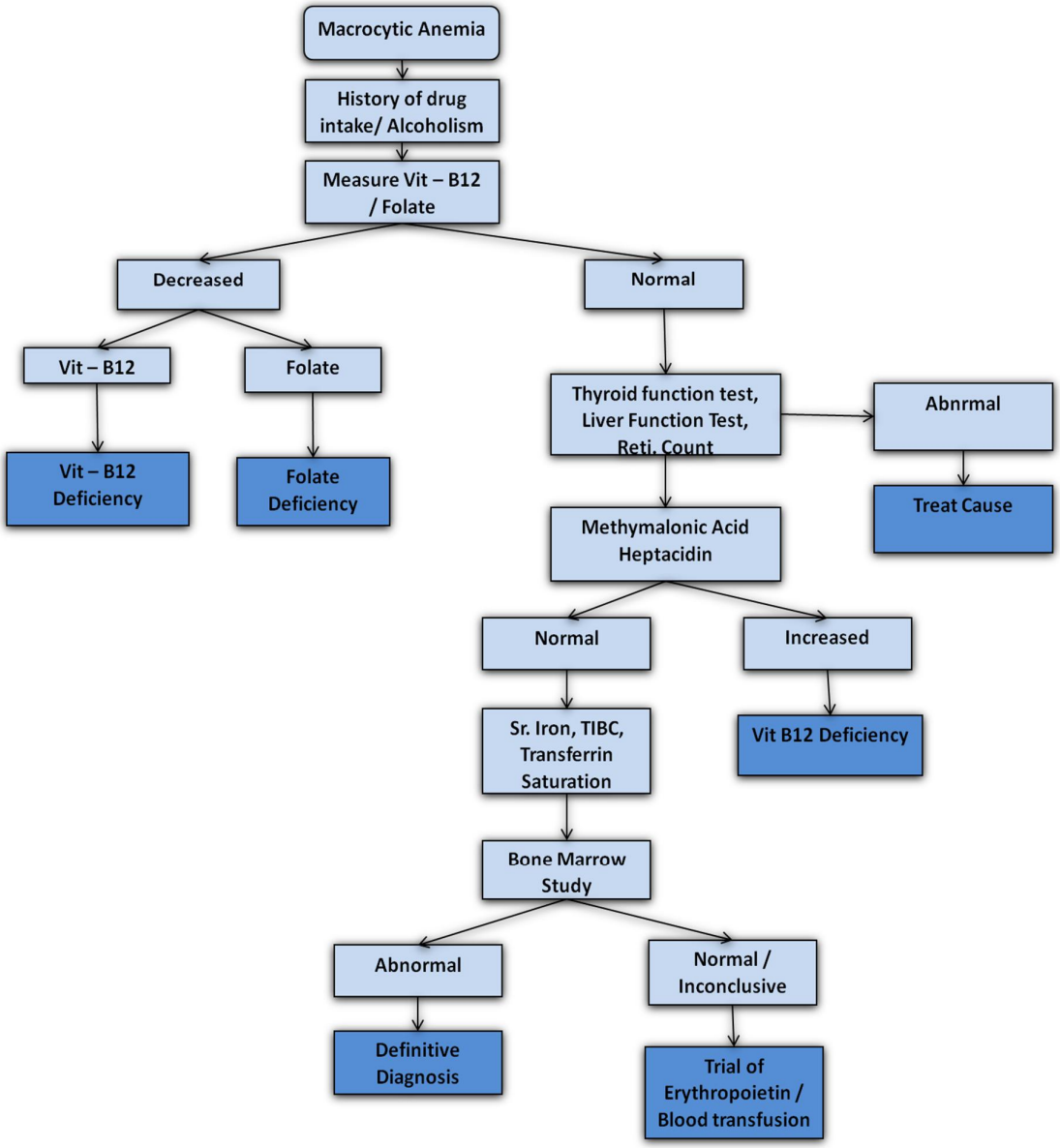
the entire GI tract is done to rule out malignancy. Bone marrow is evaluated by bone marrow biopsy and trephine biopsy. For selected endocrine disorders concerned hormone status is seen. Liver function tests are also done.

Additional measurements include serum erythropoietin, pro inflammatory markers like C reactive protein, interleukin 6, TNF- alpha. Hepcidin is important modulator of iron mechanism which play an important role in the pathogenesis of ACI. Hepcidin will prove to be useful in clinical decision making.

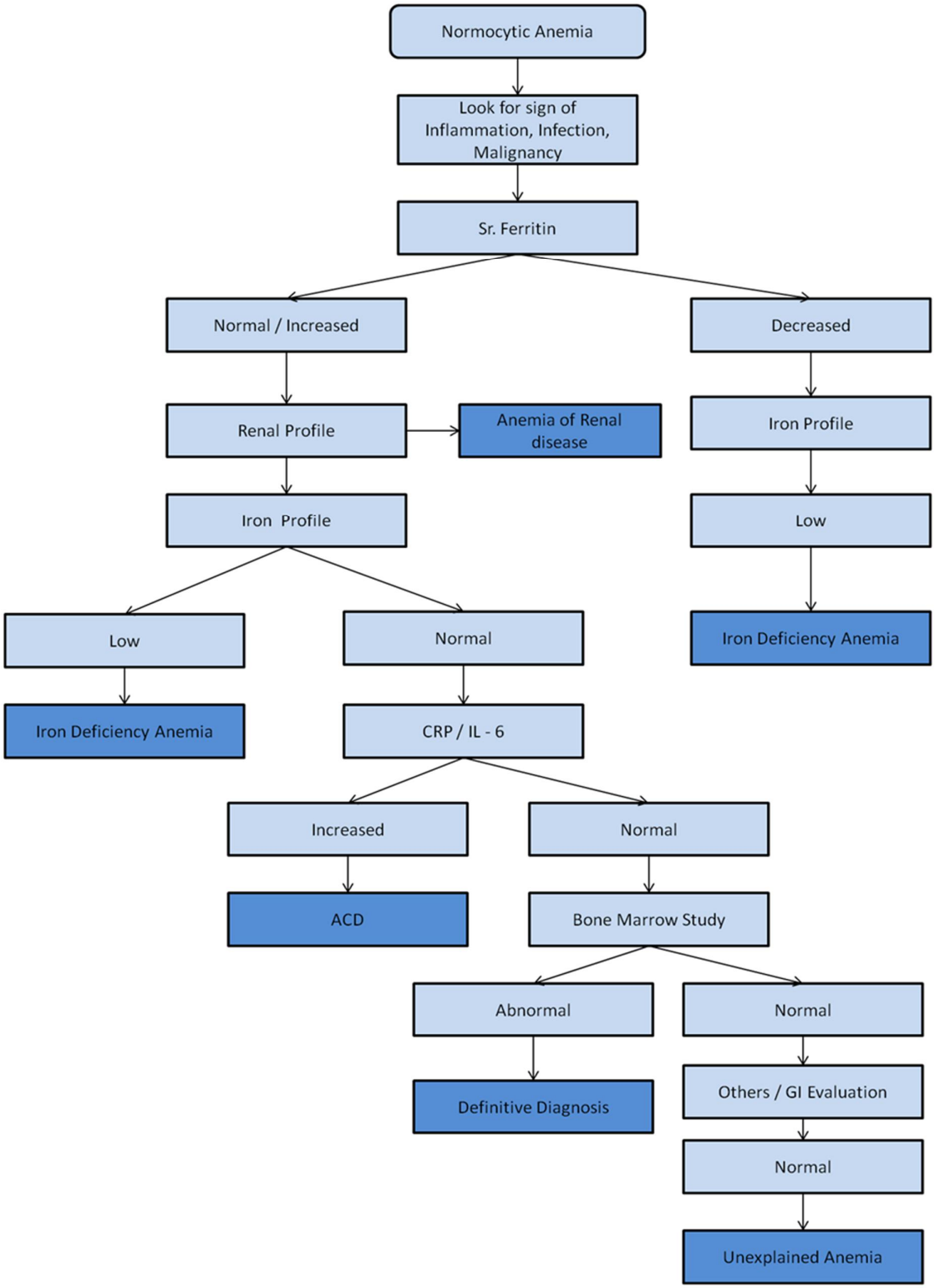
APPROACH TO MICROCYTIC ANEMIA



APPROACH TO MACROCYTIC ANEMIA



APPROACH TO NORMOCYTIC ANEMIA



INVESTIGATIONS

HEMOGLOBIN

Methods for Hb estimation:

1. Sahli's method- observer error common.
2. Artificial neural network approach (ANN).
3. Drabkin method- more reliable.
4. Acid hematin-automated counter. Useful in estimation of Hb in large batches, in tertiary laboratory.
5. Portable Hb Photometer (Hemocue)

Prevalence of anemia was higher when indirect method was used compared to direct method or the Hemocue . This may have been caused by the blood on the filter paper very incompletely dissolved, although the technician soaked the paper in Drabkin's solution.

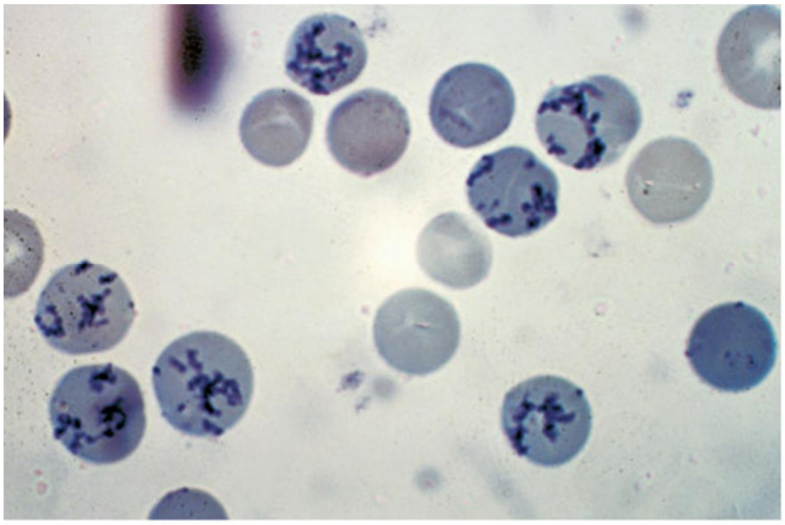
Larger differences in the estimated prevalence of anemia determined by two different methods mean a methodological difference should be examined critically before the results of different surveys are compared.

Hemoglobin concentration assessed in capillary blood was slightly lower than that assessed by venous blood. This is because the capillary blood vessel is small, the red cell volume of the capillary blood is 1-3 % lower than the venous blood.

Reticulocyte count

Reticulocyte count is one of the basic investigations done in anemia. It is a measure of immature red blood cells without a cell nucleus. It is a good predictor of bone marrow activity. Reticulocytes develop and mature in the red bone marrow and then circulate in blood stream for a day and then mature into mature RBC. On Romanowsy stain they appear slightly bluer and slightly larger with increased MCV.

- Normal range : 0.5-1.5 %
- Reticulocyte production index is an absolute measure of marrow function.
- Reticulocyte index > 2 % - adequate response
- Reticulocyte index < 2 % - hypoproliferation of bone marrow



RETICULOCYTES: Methylene blue stain demonstrates residual RNA in newly made red cells

This is calculated as

Reticulocyte production index / absolute reticulocyte count = % of Reticulocyte × patient Hemotocrit / Normal Hemotocrit

High reticulocyte occur in:

- Hemolytic Anemia
- Acute or chronic hemorrhage

Low reticulocyte occur in:

- ACD
- Nutritional anemia
- Bone marrow malignancies
- Aplastic anemia

PERIPHERAL SMEAR

Peripheral smear is an essential investigation in all cases of anemia. After diagnosis of anemia is established with Hb levels and other indices, peripheral smear is the next important investigation to be done. If found grossly abnormal bone marrow aspiration or biopsy becomes very essential.

USES:

1. To Classify different types of Anemia
2. To investigate hemotological problems
3. To look for parasites like Malaria/Filaria

Sterile blood drop is placed on one end of the slide and with a spreader slide, the blood is dispersed over the length of the slide. Slide is then air dried and fixed with methanol. Romanowsky/ Wright's/ Geimsa staining is performed. Wright Geimsa stain is commonly used.

The cells in the monolayer film is counted and differentiated. Total number of RBC, WBC and platelets are counted. Abnormal red cell morphology or red cell inclusions are assessed. White cell abnormalities and platelets morphology are also assessed. Presence of blast cells, normoblasts were also noted.

Sr.FERRITIN

Sr. ferritin reflects the total body iron stores. Ferritin is globular protein complex consisting of 24 protein sub units. It exists in soluble and non toxic form. Ferritin is an acute phase protein heme increased in chronic inflammatory conditions.

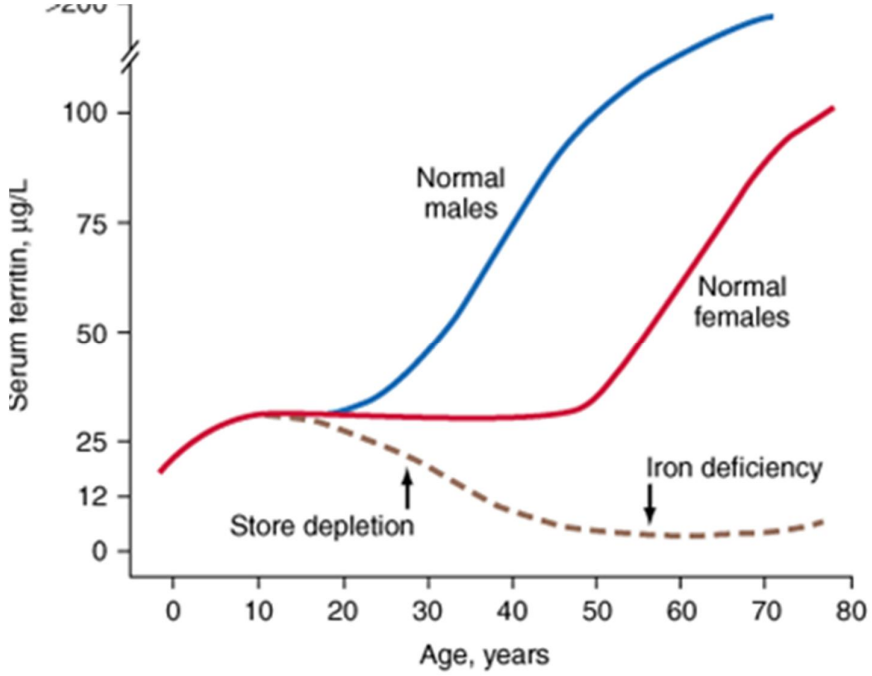
Normal ferritin levels:

- Men – 20 to 300 ng/dl
- Women- 15 to 150 ng/dl

IMPLICATION OF SERUM. FERRITN

- Iron deficiency anemia: Sr. ferritin <10 ng/dl
- Anemia of chronic diseases: Sr. ferritin >60 ng/dl
- Moderate increase in Sr.ferritin occurs in inflammatory conditions like chronic renal diseases, Rheumatoid arthritis and malignancies.
- High serum ferritin values occurs in ESRD and Hepatitis.
- Low serum ferritin:
    - Hypothyroidism
    - Vitamin C deficiency
    - Celiac disease
    - Vegetarian

Ferritin is also used as a marker for iron overload states like hemosiderosis, hemochromatosis, etc. High serum ferritin is risk factor for Myocardial Infarction in men.



Iron is stored within the cells complexed protein as ferritin. Under normal conditions serum ferritin correlates well with total body iron stores. Hence serum ferritin is used to estimate iron stores. Adult males have values around 100 µg/dl compared to females averaging 30µg/dl. Serum ferritin level falls < 15µg/dl as the iron stores depletes with age.

METHODS FOR FERRITIN ESTIMATION

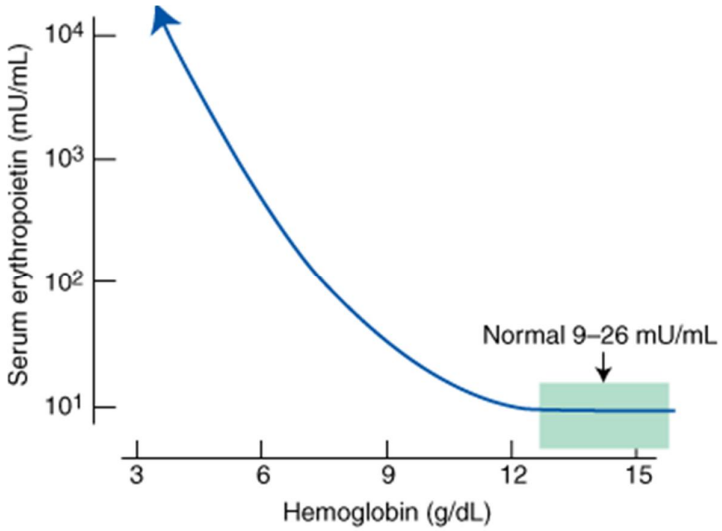
1. ELISA- method for quantitative determination of ferritin in serum or plasma. Sensitivity- 92.4%, specificity- 94.6%
2. Radio immunoassay

ERYTHROPOIETIN

EPO is an important glycoprotein that is secreted from the kidney and small proportion in the liver hepatocytes. EPO level increases the production of erythropoietic progenitor cells to a lesser extent and mainly decreases the apoptosis of these progenitor cells. Reticulocyte is a red blood cell which has lost its nucleus retaining its polyribosomal nuclear pattern. These reticulocytes lose their ribosomal pattern in 1-4 days and become red blood cells. Impaired EPO levels is considered reason for anemia in elderly. The EPO level in elderly shows a lower slope of rise suggesting failure of compensatory increase. Supporting this hypothesis administration of EPO and iron shows improvement in these patients.

EPO is responsible for day to day RBC production and the ambient normal level is measured by ferritin immunoassay. The normal level is between 10- 25 u/l. When EPO is stimulated, red cell production increase four to five fold within a week period. The functional capacity of

erythropoietin requires normal renal parameters, good functional bone marrow, and substrates for Hb synthesis.



When the Hb decrease to 12.8 g/dl serum erythropoietin levels increase longitudinally. As age progressed the level of erythropoietin needed to sustain normal Hb level appear to increase.

BONE MARROW ASPIRATION

Aspiration of the bone is done via a wide bore short beveled needle fitted with a stillete inserted into the bone marrow cavity. There is adjustable guard to prevent over penetration. This Diagnostic test, though very useful is not done in all anemic patients, as it is an invasive procedure.

The test is carried out when establishing the diagnosis is a must and in low volumes of Hemoglobin and in suspicion of hematological

malignancies. Advantage of this procedure is that the films that are prepared are examined immediately.

Commonest site used are

1. Iliac crest
2. Body of sternum

Local anesthesia is infiltrated into the periosteum of the bone, then the needle is inserted into the bone through to and fro rotation. After cavity penetration, stillette is withdrawn and a tightly fitting syringe is attached. Strong and brief suction done and about 0.2 ml of bone marrow tissue with peripheral blood is collected.

Film preparation is started immediately by placing the aspirated material on glass slide and spreading of particles done. Around 3-4 slides are prepared using the above technique. Air dried films are then fixed with respective stains.

1. Usual Romanowsky stain applied.
    a. It gives details of the developing cells like normoblastic or megaloblastic
    b. Proportion of different cells lines like myeloid: erythroid ratio
    c. Presence of cells foreign to the marrow like secondary carcinoma, abnormal macrophages(storage disorders)

d. Finally the cellularity of the marrow is also determined.

e. To detect leukemic cells.

2. Iron stain: To assess the amount of iron in the reticulo endothelial stores like macrophages and as fine granules (sideroblastic granules) in developing erythroblasts.

BONE MARROW TREPHINE BIOPSY

This is superior to bone marrow aspiration. Done to detect types of neoplastic cells, to detect Foci of lymphoma and used for staging of lymphoma. The main disadvantage is that the foci of neoplasia and hypoplasia are not evenly distributed and single biopsy may not be useful

INDICATIONS OF BONE MARROW BIOPSY

1. Myelodysplastic syndrome
2. Pancytopenias
3. Monoclonal gammopathy
4. Undiagnosed and untreated anemia
5. Immature white and nucleated red cells
6. Indeterminate iron stores

MYELO DYSPLASTIC SYNDROME (MDS)

Primary disorders of hemotopoiesis are common in people >65 years especially MDS with median age of 7th decade of life. Many cases of unexplained anemia in elderly can be because of MDS as it presents as normocytic or macrocytic anemia, especially when only the erythroid lineage is involved. MDS constitute a heterogeneous group of malignant bone marrow disorder characterized by ineffective haematopoeisis and increased risk of leukemic evolution. It is still a morphological and clinical diagnosis and careful assessment is required for adequate risk evaluation. Incidence of MDS is 4.5 per 100,000 yearly.

Risk factors are smoking, exposure to organic solvents, radiation, male patient having a first degree relative affected by hematopoietic malignancy, patients presenting with unexplained anaemia, infection, bleeding. Bone marrow is usually hyper or normo cellular and a minority hypocellular.

Pathogenesis of MDS

MDS is considered as a clonal disorder of early hematopoietic progenitor or stem cell. Increased apoptosis in the hematopoietic progenitor resulting in peripheral cytopenia is the hallmark of MDS. A

minority of MDS patients are on the diagnostic border of MDS, Aplastic anaemia and Paroxsymal Noctural Hemoglobinemia .

As on date no single genetic lesion has been shown to be sufficient for developing the disease .Pathogenesis is epileptic alteration in promoter hypermethylation and histone deacetylation.

FEATURES SUGGESTIVE OF A PRIMARY HEMOTOLOGIAL DISORDER

History and physical examination:

1. Splenomegaly or unexplained lymphadenopathy
2. Constitutional symptoms
    a. Unexplained fever
    b. Unintentional weight loss
    c. Drenching night sweats
    d. Bone pain
3. Treatment with Radiotherapy/Chemotherapy

Hemotological profile in MDS

1. Neutropenia or thrombocytopenia with anemia
2. Oval macrocytosis

3. Basophilia
4. Appearance of atypical cells on peripheral blood smears
5. Early myeloid cells
6. Hypogranular or dysplastic neutrophils
7. Dacrocytes
8. Hypogranular platelets.

WHO Classification designates five categories in the spectrum of MDS

1) Refractory anemia
2) Refractory anemia with ringed sideroblasts
3) Refractory anemia with multilineage dysplasia
4) Refractory Anemia with Excess Blast (RAEB)
5) Isolated 5q abnormality

Note: Now RAEB has been eliminated and included in the diagnosis of AML.

ETIOLOGY of MDS

1. Exposure to benzene
2. Chemotherapeutic agents
3. Topoisomerase inhibitors

4. Radiation
5. Genetic diseases like Fanconi's anemia

PATHOGENESIS of MDS

These disorders arise from clonal expansion of a multipotent hemotopoietic stem cell. Tumor suppressor genes may also play a role in the pathogenesis of MDS. Mutated RAS is more prevalent among such cases. The main pathophysiological process in MDS is ineffective hemopoiesis. It implies a decreased proportion of cells in the DNA synthesis phase and marked increase in proportion of late precursor cells undergoing apoptosis. Immune dysregulation involving increased apoptosis of marrow B lymphocytes is also noticed.

Nutritional Anemia

Loss of availability of balanced food due to either functional or financial reasons plays a pivotal role in the poor nutritional status of the elderly. Adding on the ageing changes, loss of appetite, decreased functioning of special senses like taste and smell leads to poor food intake and malnourishment.

Hence assessing the nutritional status of the elderly identifying the at risk individuals and improving their nutritional status will prevent nutritional related disorders like anemia, tuberculosis etc.[47]

Ageing of the lympho-hemotopoietic system produces a blunted response to any hemotopoietic stress and is associated with increased with incidence of neoplasia, auto immune diseases and infections in elderly.

Adding these factors to the chronological age of the older person- the functional age of the person is even higher, which accounts to greater degree of personal and medical care.

`**Iron Deficiency:**

It is the commonest cause of Nutrient deficient Anemia. It is caused by decreased oral iron intake, reduced absorption of iron, chronic blood loss. Initially Anemia may be Normochromic and Normocytic. As the disease advances, production of Microcytic Hypochromic cells are characteristic. The hematological profile of this disorder are

1. Low serum ferritin concentration
2. Low serum iron concentration
3. Increased total iron binding capacity
4. Low transferrin saturation ratio
5. Increased levels of soluble transferrin receptor.

	NORMAL	NEGATIVE IRON BALANCE	IRON DEFICIENT ERYTHROPOISIS	IRON DEFICIENCY ANEMIA
SERUM FERRITIN(ng/dl)	50-200	<20	<15	<15
SERUM IRON(µg/dl)	50-150	NL	<50	<30
TIBC	300-360	>360	>380	>400
SATURATION %	30-50	30-50	<20	<10

Vitamin B12 and Folate deficiency:

Folate and Vitamin B12 deficiency impairs the erythrocyte maturation and proliferation.

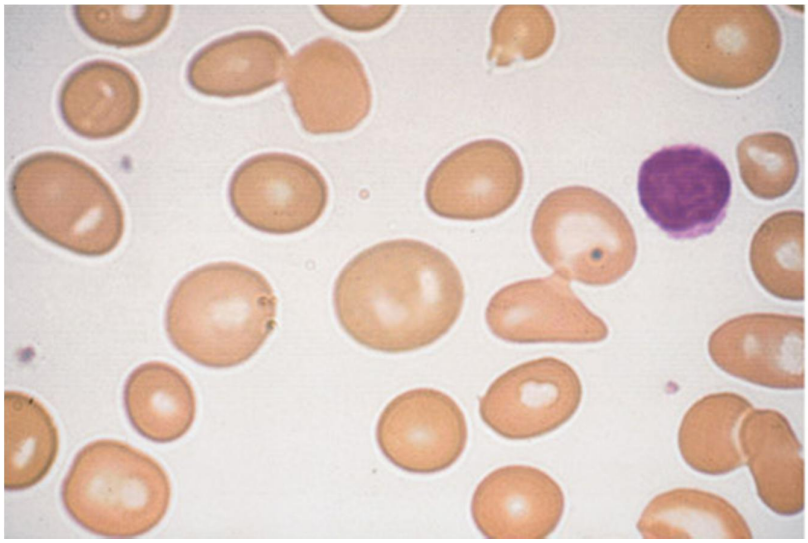
Absorption of cobalamin:

Only source of cobalamin for human is food of animal origin. Daily recommendation of cobalamin is around is 1-3 micro grams. Coblamin is absorbed both actively and passively. Passive absorption is by buccal , duodenal and ileal mucosa which is < 1%. Active absorption occurs through ileum where the cobalamin intrinsic factor complex enters the ileal cell.

Absorption of folic acid:

Folate is absorbed in the upper intestine. Absorption occurs in the form of poly glutamates which are later converted into mono glutamates. It enters the intestine cell after converting into 5, 10 methylene TetraHydrafolate.

Characteristic features of Vitamin B12 deficiency are macrocytosis, presence of hyper segmented granulocytes, giant platelets, thrombocytopenia and leucopoenia. Conditions in which B12 absorption is decreased are hypochlorhydria, surgical procedures involving the stomach, atrophic gastritis, intrinsic factor deficiency, small bowel bacterial overgrowth.



Macrocytosis: Red cells are larger than a small lymphocyte and well hemoglobinized. Often macrocytes are oval-shaped (macroovalocytes).

Anemia of Chronic Diseases (ACD)

The NHANES III report states that one out of every ten adults >65 years as anemic. Most common inflammatory processes causing ACD are autoimmune disorders, infections, etc. In ACD, typically normocytic picture is seen.

Pathology is inability to mobilize adequate iron stores from reticulo endothelial system to blood. There is no deficiency of iron as such. In ACD, there is low serum iron level but a low to normal iron binding capacity. In iron deficiency iron anemia, there is a high iron binding capacity.

Ratio of soluble transferrin receptor to log of ferritin level plays a important role to distinguish ACD from iron deficiency. A ratio of <1 favours ACD over iron deficiency anemia. The diagnosis can also be obtained measuring all important measure which is the serum ferritin levels. Ferritin gives you a good measure of iron store. Since ferritin is a important acute phase reactant, its level increases with inflammation both in acute and chronic diseases. Thus, in iron deficiency ferritin level is typically low whereas in ACD, ferritin levels is often high.

POTENTIAL ROLE OF HEPCIDIN IN ACD

It is hypothesized that hepcidin plays an important role in the anemia of inflammation. Inflammation causes activation of monocytes and T cells to produce pro inflammatory cytokines especially interleukin 6 which in turn induces the secretion of hepcidin by hepatocytes. Hepcidin binds to the membrane protein ferro protein and prevents the transfer iron from the cells.

TREATMENT

Treatment of the chronic disease responsible for the anemia is important. But this is not possible in all cases. Transfusion is considered where the hemoglobin level is < 8 mg/dl. Iron supplement should not be used in cases of ACD as there is always good iron stores in these patients. Iron therapy is harmful in presence of chronic inflammation.

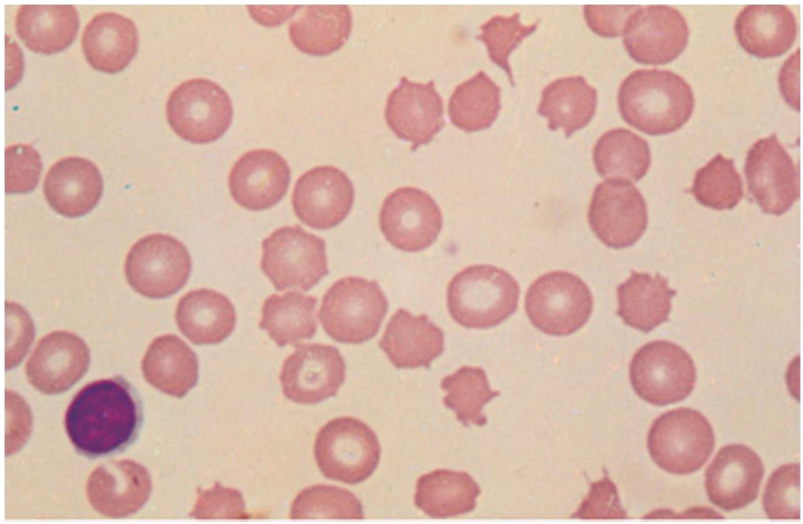
Erythropoietic drugs are found to be useful in ACD mainly in vascular and endothelial dysfunction. Use of erythropoietin increase best response especially with patients suffering from connective tissue disorders and chronic diseases.

Problems with erythropoietic drugs

a. Higher deaths with cardio vascular events
b. Progression or recurrence of certain types of cancers
c. Increased risk of venous thromboembolism

ANEMIA OF CHRONIC KIDNEY DISEASE

Erythropoietin is produced by the peritubular capillary lining cells in the kidneys. It is triggered by decreased oxygen availability in the kidneys. Decreased oxygen delivery can be a result of decreased renal blood flow, heart failure, anemia and renal arteriosclerosis. Age related decline in renal function may lead to blunted erythropoietin response and anemia.



SPUR CELLS: Spur cells are recognized as distorted red cells containing several irregularly distributed thornlike projections. Cells with this morphologic abnormality are also called acanthocytes

Treatment should maintain Hb level between 10 -12 gms/dl. Treatment with erythropoietin offers benefit in terms of quality of life in physical function. Time taken for the response depends on the degree of the disease.

MINI NUTRITIONAL ASSESSMENT

The incidence of Protein Energy Malnutrition is very low in community dwelling elderly which is about (5-10%). The frail elderly population is at increased risk of PEM and reaches values around 20 – 60 % in hospitalized/institutionalized elderly. This proportion goes unnoticed due to the lack of significant methods to detect malnutrition in elderly persons.[52] Malnutrition in elderly will cause greater susceptibility to infection, longer stay in the hospital and mortality.

MNA is composed of simple measurements and questions that can be completed in 10 min. It provides a rapid assessment of nutritional status of the elderly people to facilitate nutrition intervention. Mini nutritional assessment score has been validated in the elderly population with three successive studies.[51]

1. Anthropometric measurements- height, weight, and weight loss.
2. Dietary questionnaire (eight questions related to number of meals, food and fluid intake and autonomy of feeding)

3. Global assessment (six questions related to the lifestyle, medication and mobility)

4. Subjective assessment (self perception of health and nutrition)

MNA SCORE OF MAXIMUM 30 POINTS

>24 - well nourished / normal

17 – 23.5 – at risk of malnutrition / borderline

<17 – malnourished

Major advantage of MNA is that it does not require measurements that are difficult to assess such as blood values, but since it is a questionnaire inter-individual variation are more. MNA score correlates well with various aspects of health. Many studies reveal increased mortality in elderly malnourished individuals when compared to well-nourished individuals. MNA is a predictor of outcome and cost of care in hospital settings, while in home care patients it is related to meal patterns and chronic medical conditions. Overall sensitivity of MNA was 96 % and specificity was 98 %.

REVIEW OF LITERATURE

1. AMIT BHASIN and MEDHA Y RAO (Department of Medicine, M S Ramaih Medical College)

   Characteristics of anemia in elderly. This study was warranted to identify the underlying cause and clinical profile of elderly patients with anemia.

2. IZAKS GJ. et al. (Department of general medicine, Leiden university medical center, the Netherlands)

   The objective of this study is to correlate the association between hemoglobin concentration and cause specific mortality rate in the elderly persons. The study was done for a period of ten years from 1986 to 1996. The study concluded that the mortality risk in patients of age above 85 was more, when WHO criterion for anemia is considered.

3. ZAKAI NA et al. (Department of medicine, university of Vermont, Burlington USA)

   In this study community dwelling men and women more than 65 years were enrolled. This study also showed that anemia defined by WHO is associated with increased mortality in patients more than 65 years.

4. WOODMAN R et al. (Bridgewater , NJ, USA)

   NHANES III study showed that anemia was present 11 % of men, 10.2 % of women. The ratio rises 20% more in people with age more than 85.

5. NEUKIRCHEN J et al. Incidence and prevalence of myelodysplastic syndrome. This study found out that the incidence and prevalence of MDS was higher in men than in women and increases sharply with increase in age.
6. PATEL KV et al. (National institute of ageing, Bethesda, USA)

   This study concluded that anemia was associated with increased risk death in white males. Conversely older blacks were not at risk for adverse effects.

7. PENNIX BW et al.

   This study shows anemia was associated with decline in ability of performance assessed by short physical performance battery.

8. CHAVES et al.

   This study showed a synergistic interaction between anemia and cardio vascular disease. Study also showed the relation of anemia

with impaired cognition by using mini mental status examination (MMSE score).

Patient with anemia had mild impaired cognition under MMSE score less than 24.

9. BALDUCCI et al.

   This study reviewed the causes and consequences of anemia and also highlighted the chances of stimulation of cancer growth with erythropoietin stimulating agents.

10. Ferruci et al.

    This study showed the relation between erythropoietin and declining renal function.

11. JACK M GUARALNIK (National institute of ageing, Philadelphia)

    This result shows that men are having high prevalence of anemia than women after the age of 75, and reaches highest prevalence of 26% at 85 years of age.

12. CHOI CW et al.

    Cross sectional study of urban Korean population. This study correlated female sex, old age, lower albumin level, higher

creatinine level as independent risk factors for the prevalence of anemia.

13. CAPURRO (University of Chile)

This study correlated role of inflammation in micro nutrient deficiency and prevalence of anemia. They concluded that anemia was less prevalent in free living aged patient than institutionalized elderly people.

14. ASTOR et al. (Johns Hopkins school of public health)

This study correlated the association of GFR with prevalence of anemia. They concluded that estimated GFR below 60 ml/ min / 1.73 mts(2) was associated with higher prevalence of anemia.

MATERIALS AND METHODOLOGY

SETTING:

Patients attending Outpatient clinics of Department of Geriatrics and those who are admitted in Geriatric Medicine ward in Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai.

ETHICAL COMMITTEE APPROVAL:

Ethical committee clearance obtained from the Institutional Ethical committee of Madras medical college as per the meeting held on June 2012.

STUDY DESIGN:

Cross Sectional , Clinical, Observational study

STUDY PERIOD:

June 2012 to December 2012

CONSENT:

Consent was obtained from all patients, who participated in the study.

FINANCIAL SUPPORT:

NIL

STUDY POPULATION:

93 patients attending both outpatient clinic and inpatients in Department of Geriatric Medicine, Madras Medical College, Govt. General Hospital.

INCLUSION CRITERIA:

- Age above 65yrs.
- Patients with Hb levels of <12g/dl in women and <13g/dl in men.

EXCLUSION CRITERIA:

- All Critically ill subjects.

DETAILS OF STUDY:

Total 93 subjects fulfilling the WHO criteria for anemia definition (men Hb<13g/dl and women Hb<12g/dl) were enrolled in the study. Both sexes were included in study group.

All 93 subjects were subjected to Mini Nutritional Assessment questionnaire and MNA scoring was also done. All subjects Anthropometric assessment was done and BMI, Mid-arm circumference

and calf circumference measurements taken. Subjects were questioned accordingly for the answers and a total score out of 30 was obtained by adding points for each question.

Detailed history taking and clinical examination was performed in patients diagnosed with anaemia.

Using a dry syringe venous blood of 10ml drawn under aseptic precautions from patients with their consent, and the following relevant investigations done.

Hemoglobin concentration assessed in capillary blood was slightly lower than that assessed by venous blood. This is because the capillary blood vessel is small, the red cell volume of the capillary blood is 1-3 % lower than the venous blood. Considering this fact we have chosen venous blood collection in our study.

Subjects underwent the following investigations like total and differential counts , erythrocyte sedimentation rate , platelet count , and red cell indices like mean corpuscular volume , Mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration , packed cell volume, reticulocyte count and other biochemical investigations like renal function test and liver function test also done. Urine samples also were taken for analysis with patients consent.

All subjects underwent Peripheral Smear study which was the important parameter in the classification of anemia. Based on the patient Peripheral Smear picture patients were classified as microcytic (MCV< 80), Macrocytic (MCV 80-100) and Normocytic (MCV > 100).

Sr. Ferritin assay was done in all patients as a measure of iron stores. Bone marrow aspiration was done in patients with blood smear showing immature white cells, nucleated red cells ,in patients with severe anemia , intermediate iron stores , unexplained anemia and in suspicion of other haematological malingnancy like Myelodysplastic Syndrome.

Other additional tests include serum iron, transferrin saturation are done for iron deficiency anemia.

For evaluation of hemolysis serum lactate dehydrogenase, indirect bilirubin concentration is measured.

In patients with abnormal renal profile estimated Glomular Filtration Rate (eGFR) was calculated to assess the appropriate renal function.

To evaluate occult GI bleeding, fecal occult blood was done in all patients. Upper GI endoscopy is done in patients with iron deficiency anemia, in patients with stool occult blood positivity and in subjects in whom underlying cause was not evaluated. Lower GI tract evaluation by

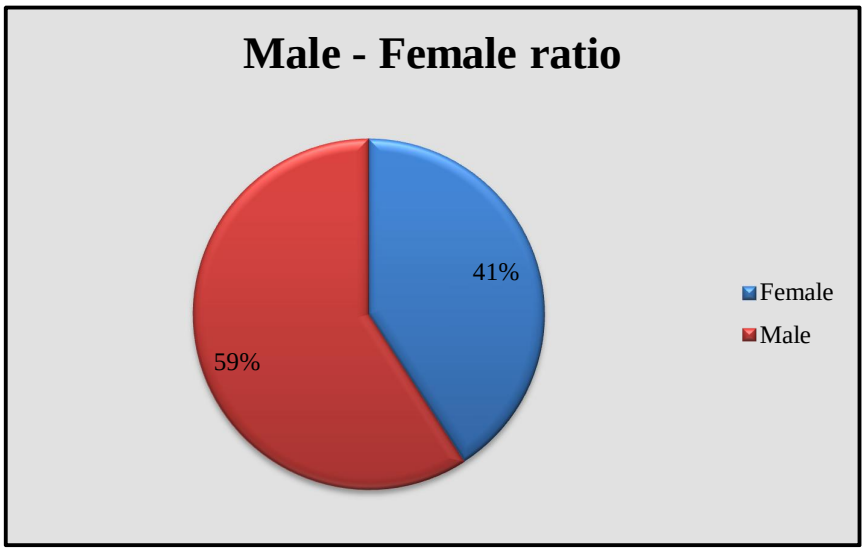
LGI scopy is done in patients with stool occult blood positivity but in whom UGI scopy was normal, to rule out malignancy and other benign GI disorders.

Vitamin B12 and Folate assays carried out in patients with Macrocytic anemia and in patients with a dimorphic picture in smear and in patients with Normocytic or Microcytic blood picture in whom no other causative factor was detected .

Additional investigations as indicated like X- ray chest, USG Abdomen & Pelvis, stool for parasites and serum electrophoresis & Direct Coombs test was done for reasoning out the underlying cause.

RESULTS AND ANALYSIS

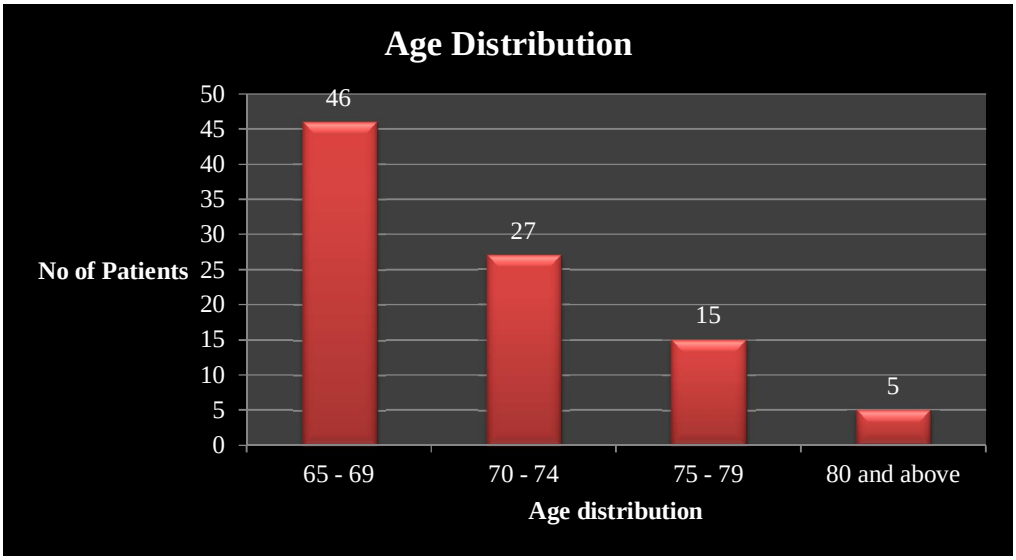
An observational study was carried out in a cohort of patients aged 65 years and above including either sex presenting to our hospital fulfilling the WHO criteria for anaemia. Patient selection was very random and non consecutive. The study was conducted for a period of six months.



In our study the percentage of male patients above 65 years with anaemia was 59 % and the prevalance percentage of females above 65 years was around 41 %. This shows that the propotion of males above 65 yrs with anemia is higher than females above 65 yrs with anemia.

This might be due to the lowered limit of WHO criteria based on Hb levels for females. Also the prevalence of anemia in males increases as age progresses with highest prevalence in males who are 85 years and older. According to the NHANES III study the prevalence of anemia in men was 11 % and for women was 10.2 %. Our study correlates well with NHANES III results.

Age distribution of patients



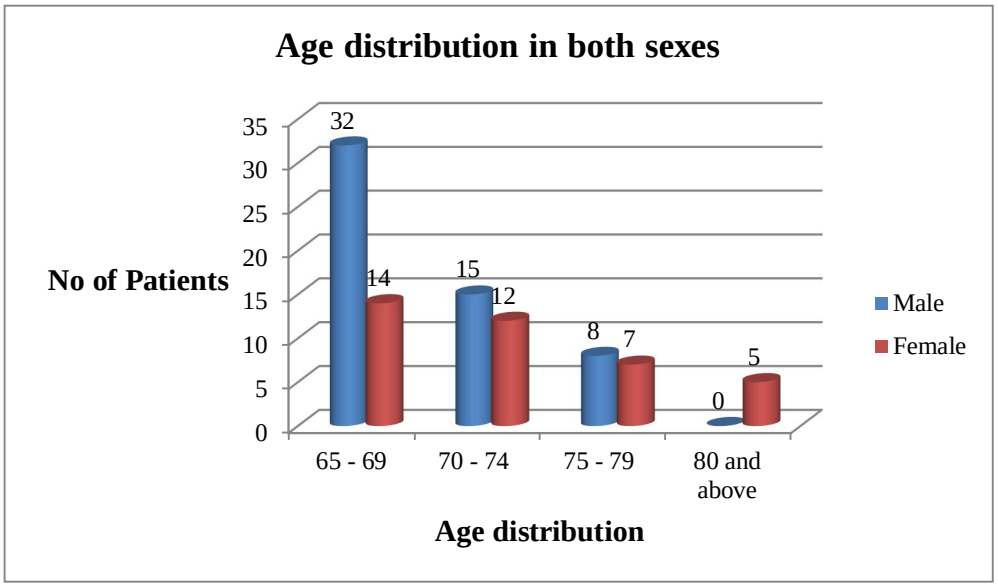
In our study age group ranges from 65 to 81 years. The mean age group was 73 years. According to Amit Bhasin and Medha Y Rao study the mean age group was 70.51 years.

The maximum number of patients were in age group of 65 – 69 which is the same as that of Amits study. The number of patients in the

age group 80 and above was very less about 5 %. This might be because of the lower life expectancy rate in this age group in developing countries like in India. Also as age progresses the morbidity and mortality rate associated with anemia increases exponentially.

In developed countries the prevalence of anemia is steadily increased with ageing and found to be highest in the age group 85 +. These significant differences were also preserved with reference to race and ethnicity.

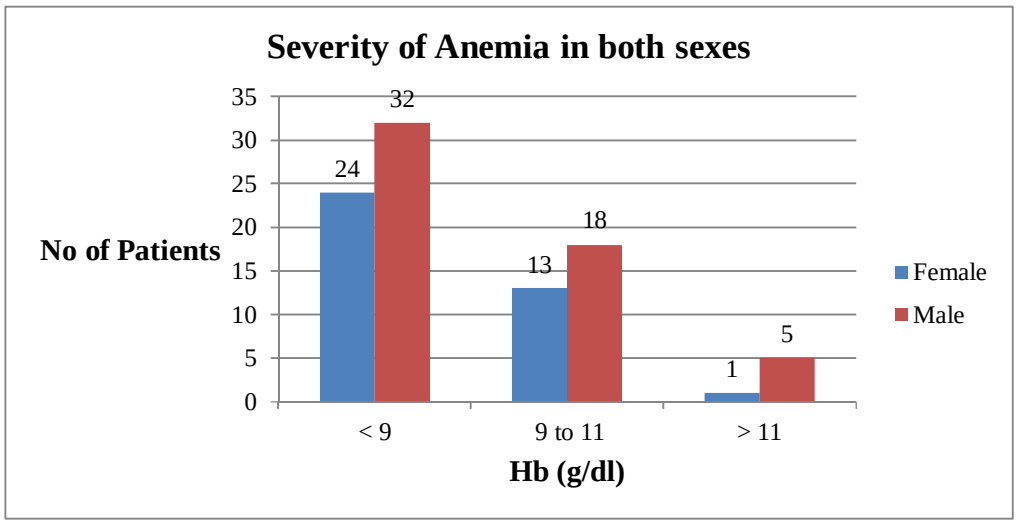
Age sex distribution



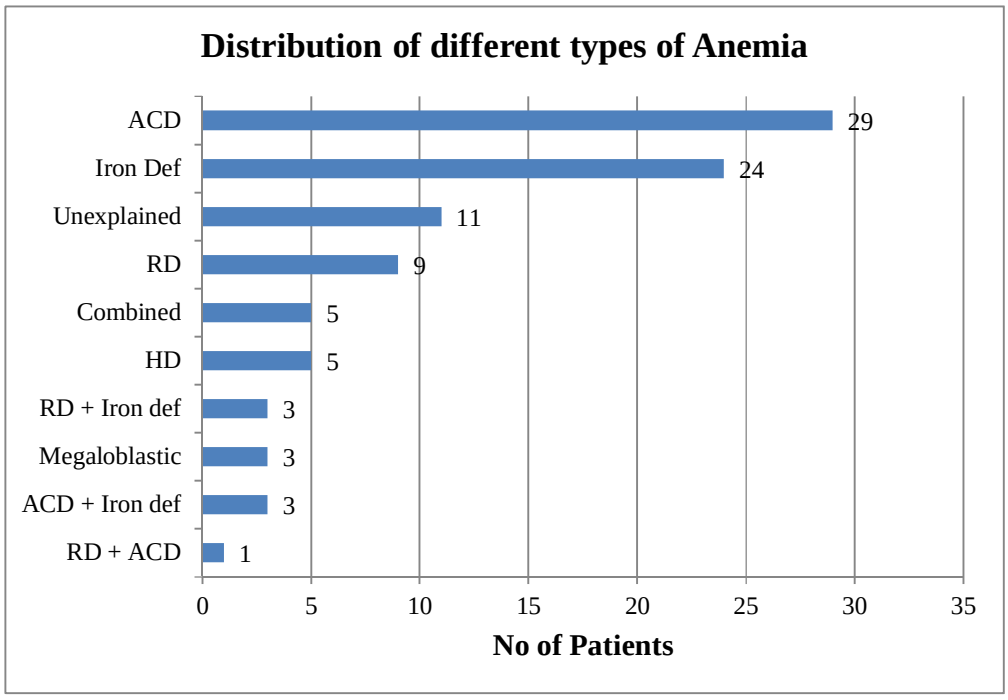
In our study males with anemia were more prevalent in the age group of 65 to 79 years. Prevalence of anemia shooted up dramatically in

females above 80 years. This correlates with previous studies which shows that prevalence of anemia in females increases above 85 yrs.

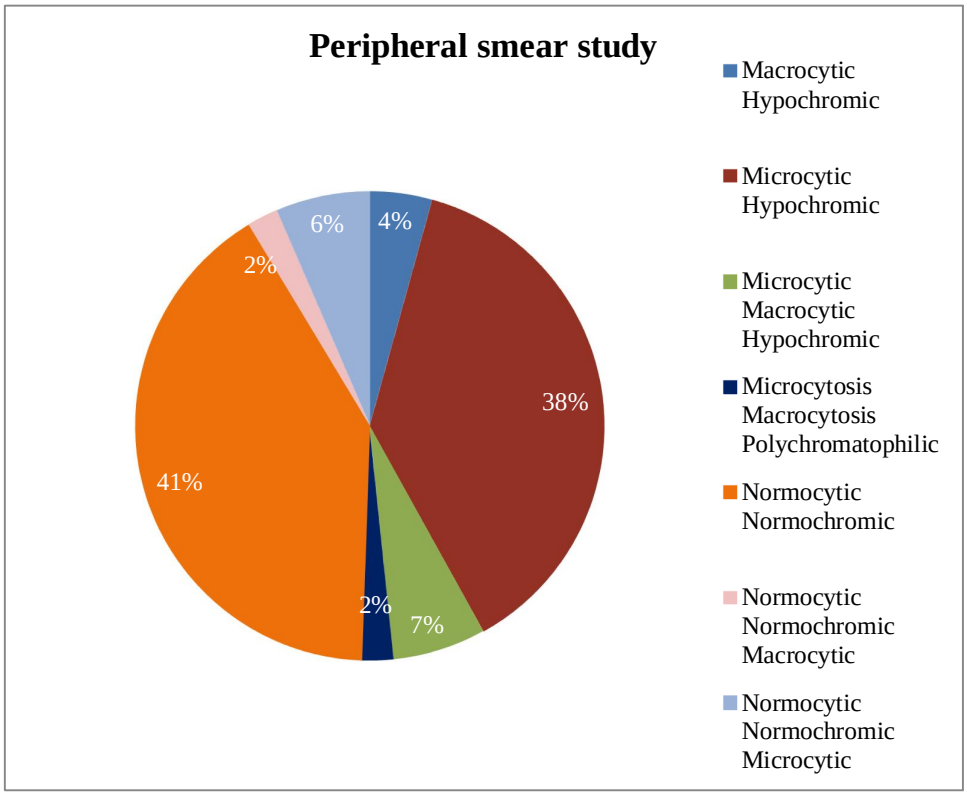
Severity of Anemia in both sexes



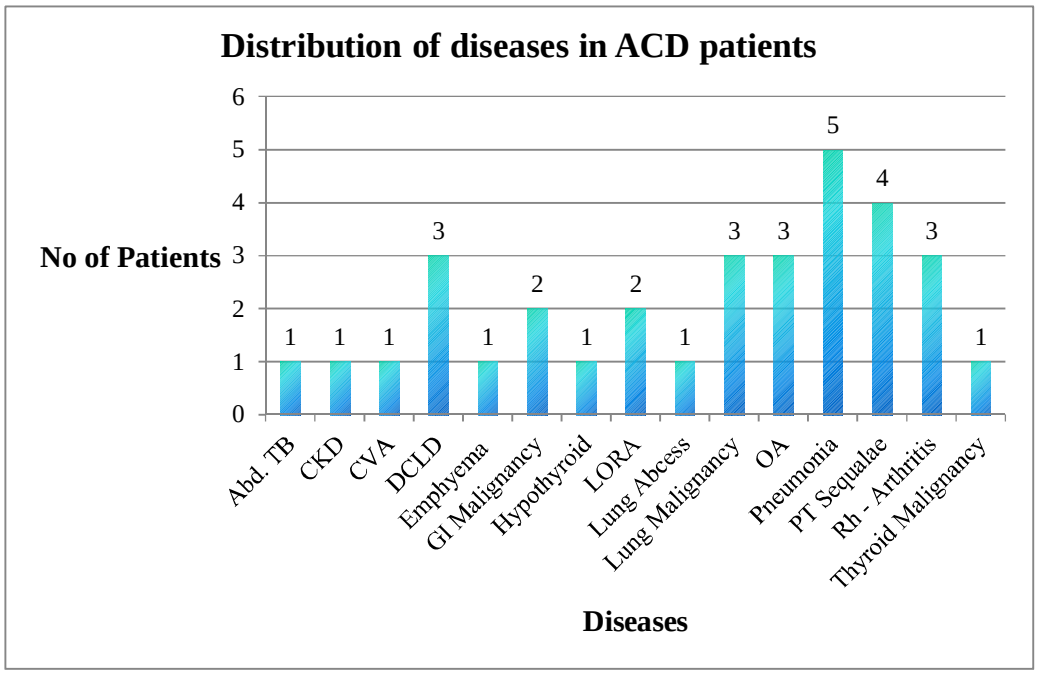
The third National Health and Nutrition Examination Survey studied the prevalence of anemia in community dwelling persons. The number of persons with severe anemia in fact was very less in this study. In this 2.8% of women and 1.6% of men have hemoglobin less than 11 gms/dl. According to this study the prevalence of severe anemia was more for women than men. In our study the prevalence of severe anemia was more in men than women. This might be the overall more number of men than women in our study.



According to the NHANES III study anemia of chronic disease, nutritional deficiency and unexplained anemia shared equal thirds in prevalence. In our observational study both ACD and Nutritional anemia shared equal proportion. Anemia of Unexplained etiology was lesser in our study as it is an institutional study.

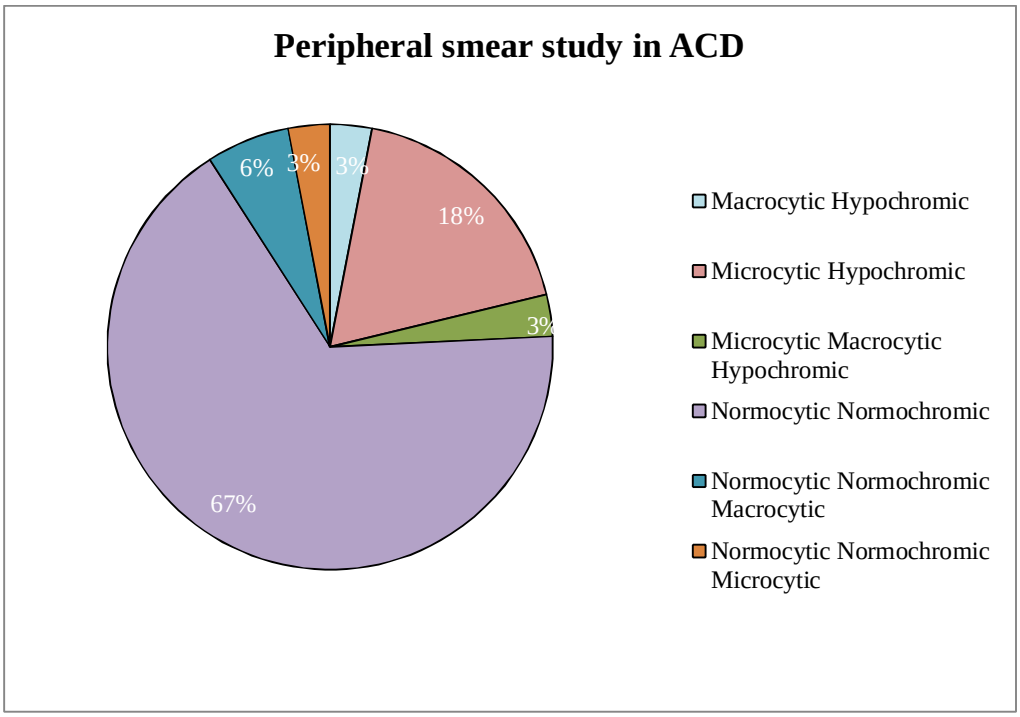


Normocytic anaemia was the commonest type of anemia in our study constituting about 41 % followed by microcytic anemia constituting about 38%. The least prevalence was the microcytic macrocytic polychromatophillic type of peripheral smear picture seen in MDS cases. Many different disorders produce anemia of normocytic normochromic type . It can occur following loss of substantial volume of blood, or in hemolysis. It also occurs in conditions causing bone marrow failure. According to our study, anemia of chronic disease was the most common and the commonest picture of anemia of chronic disease was normocytic normochromic anemia.



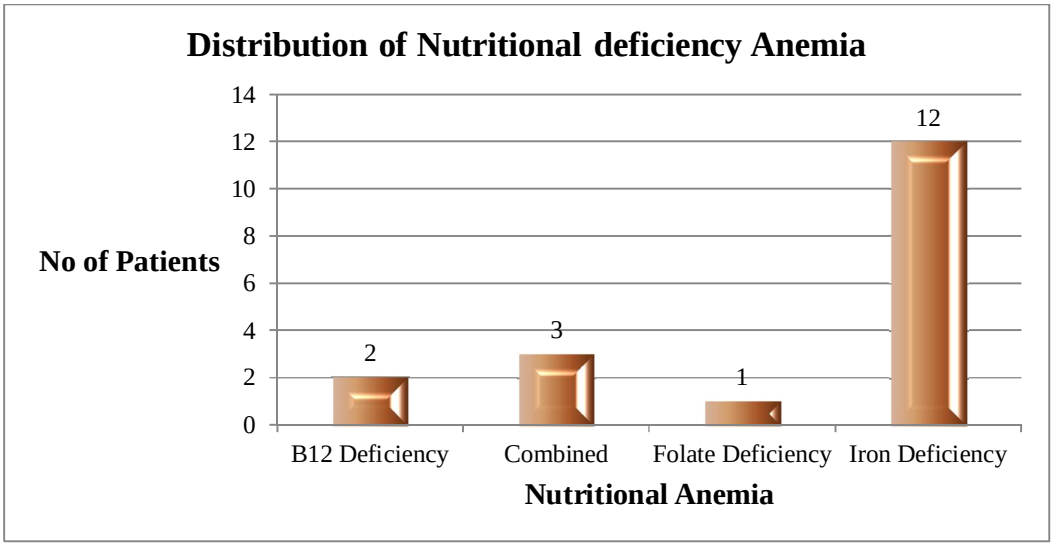
In our study chronic infection was responsible for majority of patients suffering from anemia of chronic disease . The chronic diseases included five cases of pneumonia , four cases of pulmonary tuberculosis and each one case of lung abcess, abdominal tuberculosis and emphyema . Other common causes was due to rheumatoid arthiritis , anemia due to renal diseases and malignancy.

The proposed mechanism for anemia of chronic illness is due to cytokines like IL- 1 and IL-6 and TNF – alpha which causes destruction of RBC precursors and decreases in number of erythropoietin receptors on progenitor cells.

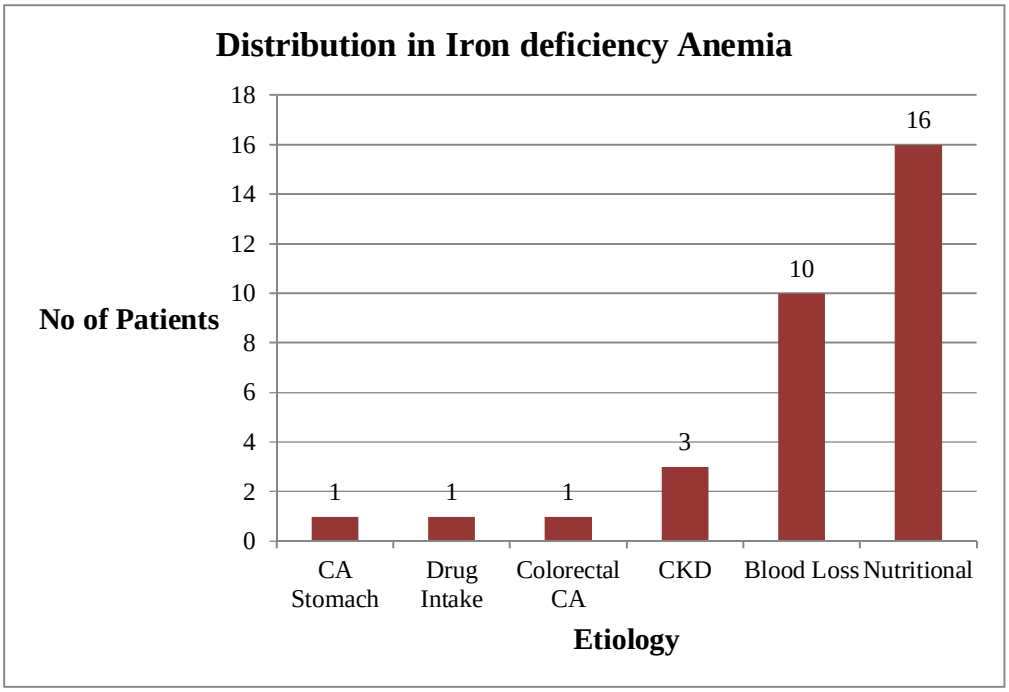


In our study most of the patients with anemia of chronic diseases had Normocytic Normochromic picture in peripheral smear study. The next common picture was Microcytic Hypochromic. This is because the main pathology of anemia of chronic disease is the effect of cytokine on erythropoiesis . Microcytosis is seen as chronic disease affects the iron metabolism and decreases its availability for erythroid precursors.

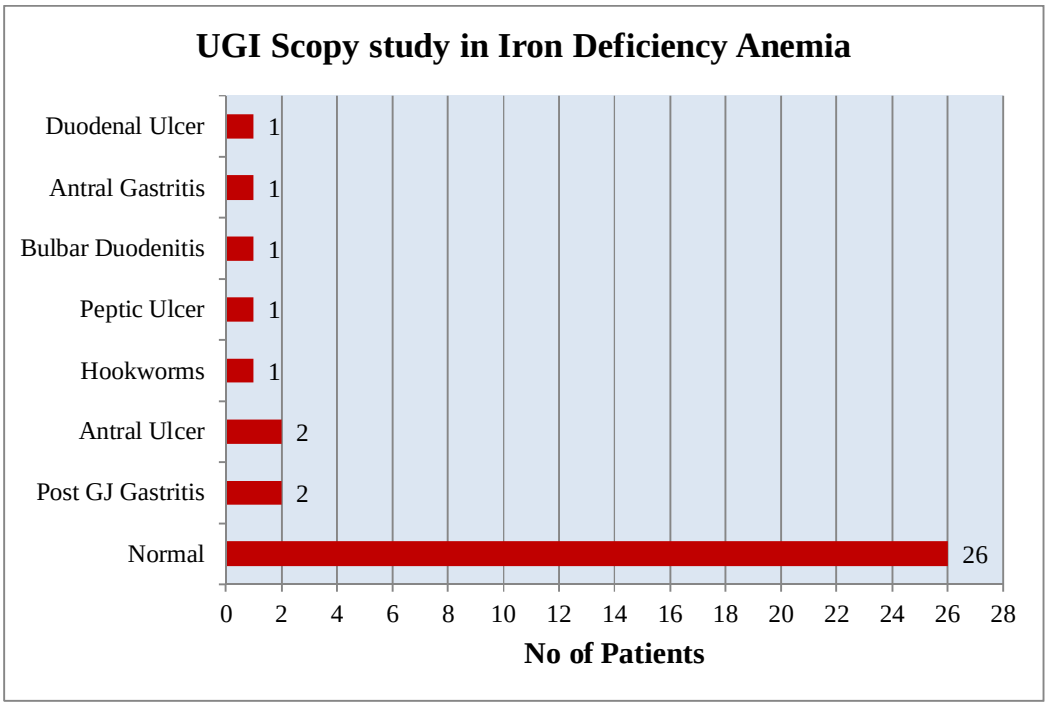
Distribution of Nutritional Deficiency Anemia



According to NHANES III study about 50 % of nutritional anemia was iron deficiency anemia. In our study about 66 % of nutritional anemia is constituted by iron deficiency anemia. This shows the burden of iron deficiency anemia in country like India. The incidence of Vitamin B12 and Folate deficiency is around 3%. Isolated Vitamin B12 deficiency is only 2% but when combined with Iron deficiency anemia is around 7%. This dimorphic nature is due to nutritional causes.

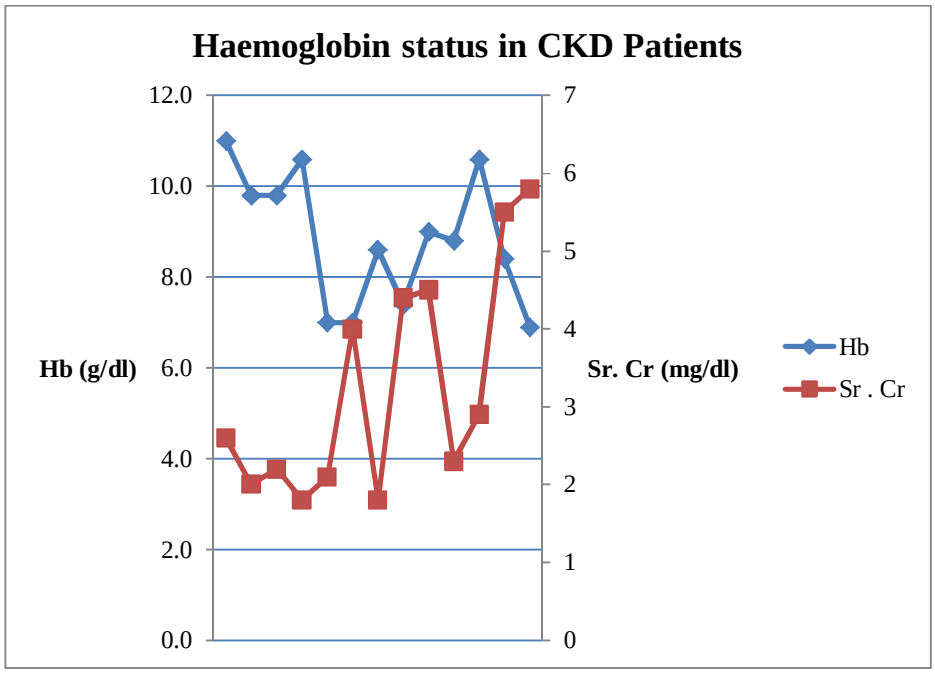


In our study the most important cause for iron deficiency anemia was nutritional causes. This is also evident from the higher incidence of subjects at risk of malnutrition in our study population. Occult blood loss was also a significant cause for iron deficiency anemia. This higher incidence highlights the importance of the need for gastrointestinal evaluation in patients presenting with iron deficiency anemia.



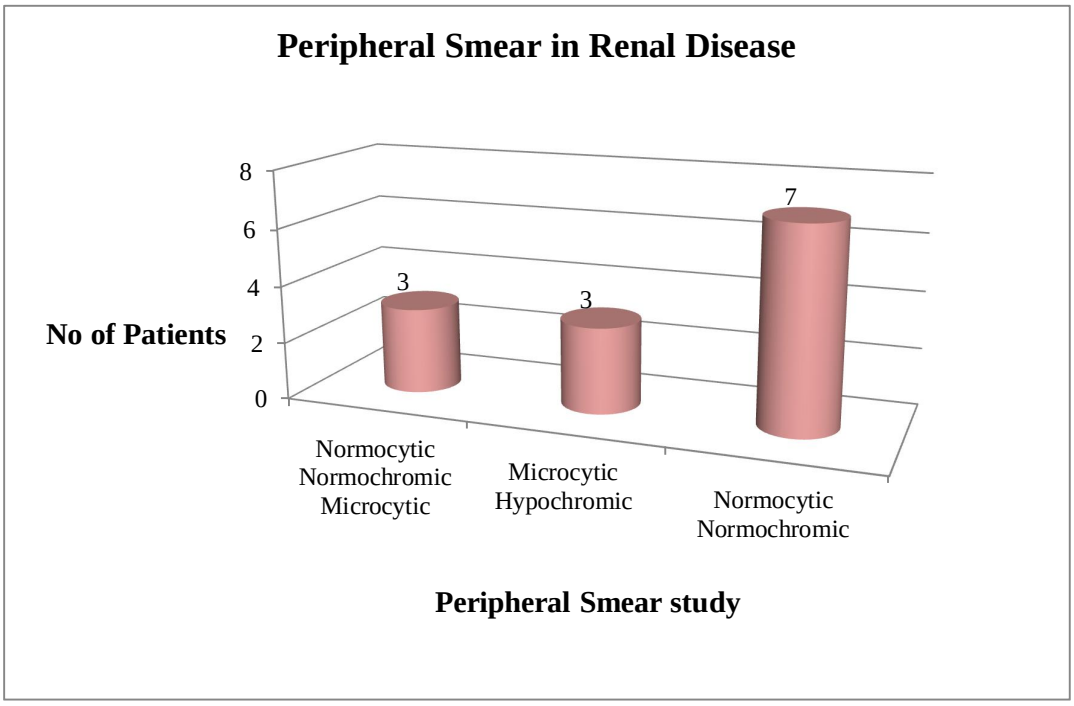
In our study patients were subjected to upper GI endoscopy to rule out blood loss in cases presenting with signs of iron deficiency anemia. Most of patients with iron deficiency anemia had normal endoscopic study. Among the abnormal GI studies incidence of gastric ulcers was more. Lesser pathologies causing iron deficiency are hookworm infection, bulbar and duodenal ulcers.

Correlation of Sr. Creatinine level and degree of anaemia



According to older studies anemia in older adults tends to be mild with Hb more than 10 g /dl. In NHANES III study less than 10% of the anemic patients had hemoglobin less than 10 g/dl. In Leiden study of patients of 85 years, 15% of the anemic patients had severe anemia. In institutionalized elderly people this prevalence was about 20%. In our study 58% of men and 25% of female were severely anemic.

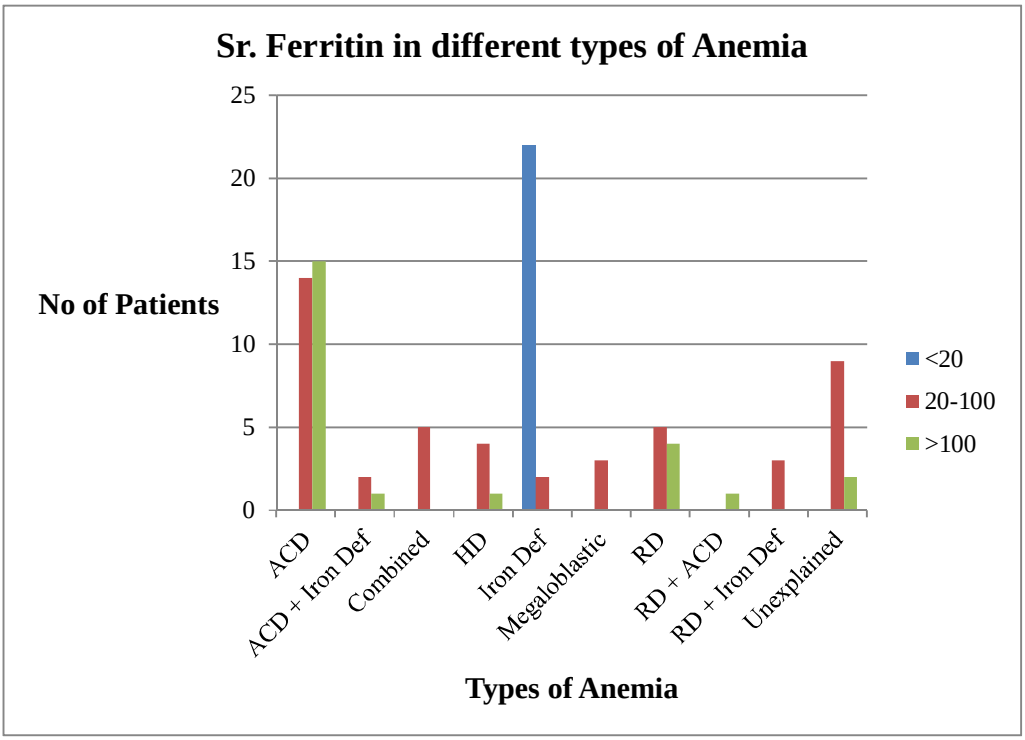
In CKD because of the negative acute phase reaction serum iron levels and percentage of iron saturation are very low. Further on analyzing the graph above the serum creatinine level does not correlate with the degree of anemia.



Anemia caused by chronic kidney disease in our study showed 50 % of patients were normocytic and normochromic . About 25 % of patients in our study with anemia of chronic disease had a microcytic picture also. This indicates an associated iron deficiency also due to ineffective erythropoiesis due to Erythropoietin deficiency.

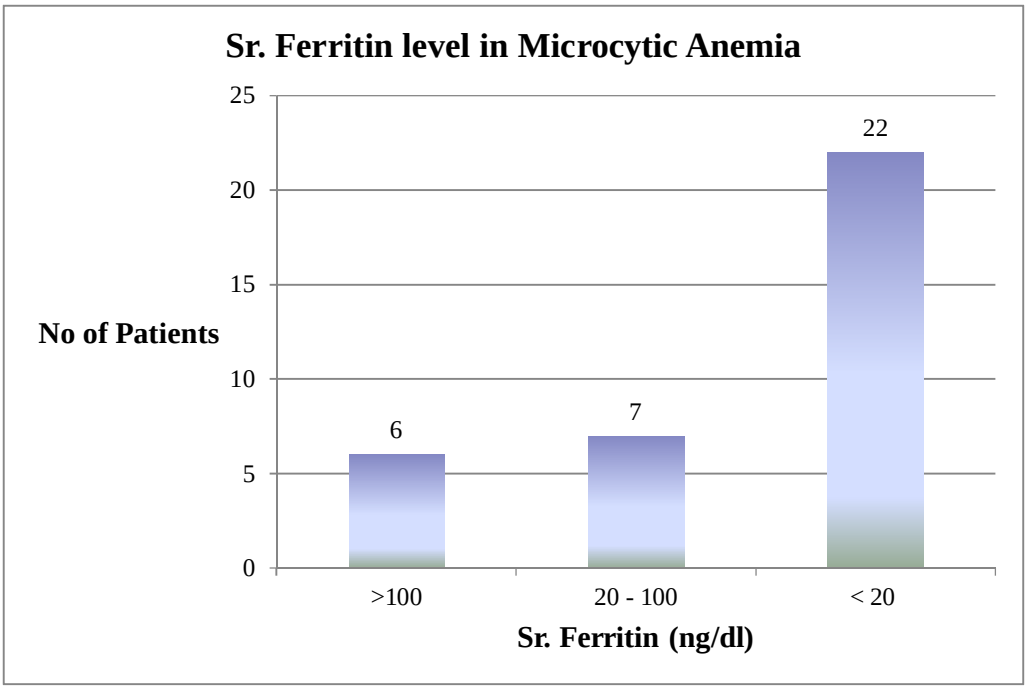
Normocytic picture is usually seen because there is a defect in red blood cell production explained by the inability of the failing kidneys to secrete Erythropoietin. There is also excessive destruction of RBC s in advanced renal failures, which explains the the presence of microcytic hypochromic anaemia. Our study correlated well with the study done by Bhalta, Aryal G et al which showed 90 % of the cases to be Normocytic, Normochromic anaemia.

Serum ferritin levels in different types of anemia



In our study Serum Ferritin level correlated with the type of anaemia . About 90 % of the cases of iron deficiency anaemia had serum level less than 20 ng/dl. About 50 % of the patients suffering from anemia of chronic disease had normal serum ferritin levels and 50 % showed increased ferritin stores. In renal disease also 50 % of patients had normal ferritin level and 50 % had increased ferritin levels. In anemia of unexplained etiology the ferritin status was normal in most of the cases. Only if the serum ferritin store is not initially low further investigations like total iron, total iron binding capacity and transferrin saturation levels are needed.

Correlation of serum Ferritin in Microcytic Anemia .

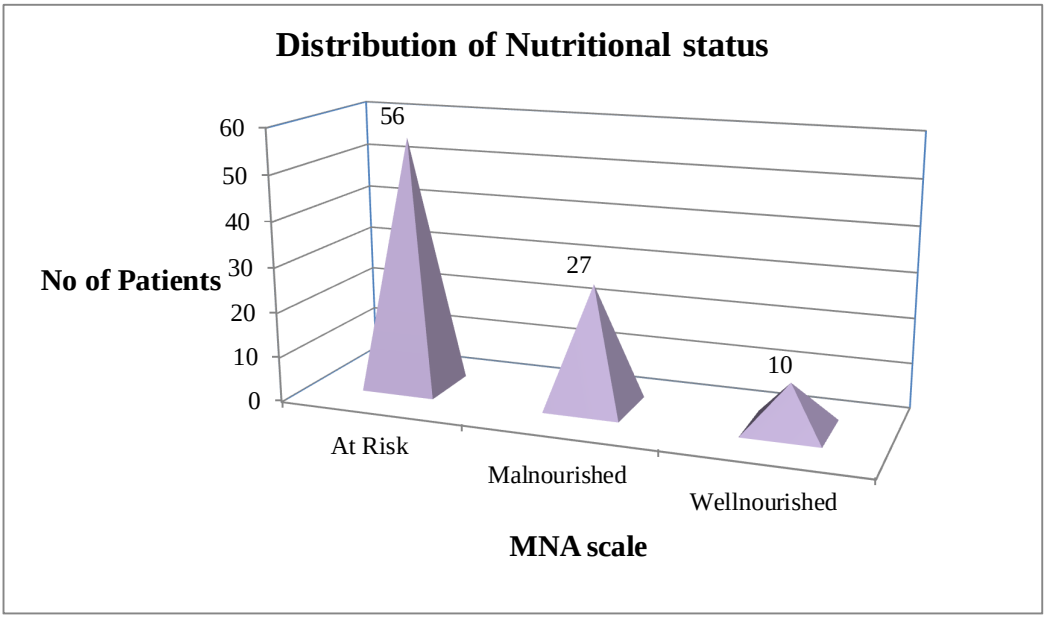


Around 22 patients had Serum Ferritin levels less than 20 ng/ dl which points to deficient iron stores. Six patients had Serum Ferritin levels more than 100 ng/dl and 7 patients had varying iron deficiency with ferritin levels between 20 – 100 ng/dl.

Serum ferritin measurement is the first recommended test in evaluating microcytosis. Low ferritin level suggest iron deficiency anemia. If the serum ferritin level is not initially low then total iron binding capacity, transferrin saturation, serum iron level and hemoglobin electrophoresis are done. In our study about 13 % of iron deficiency

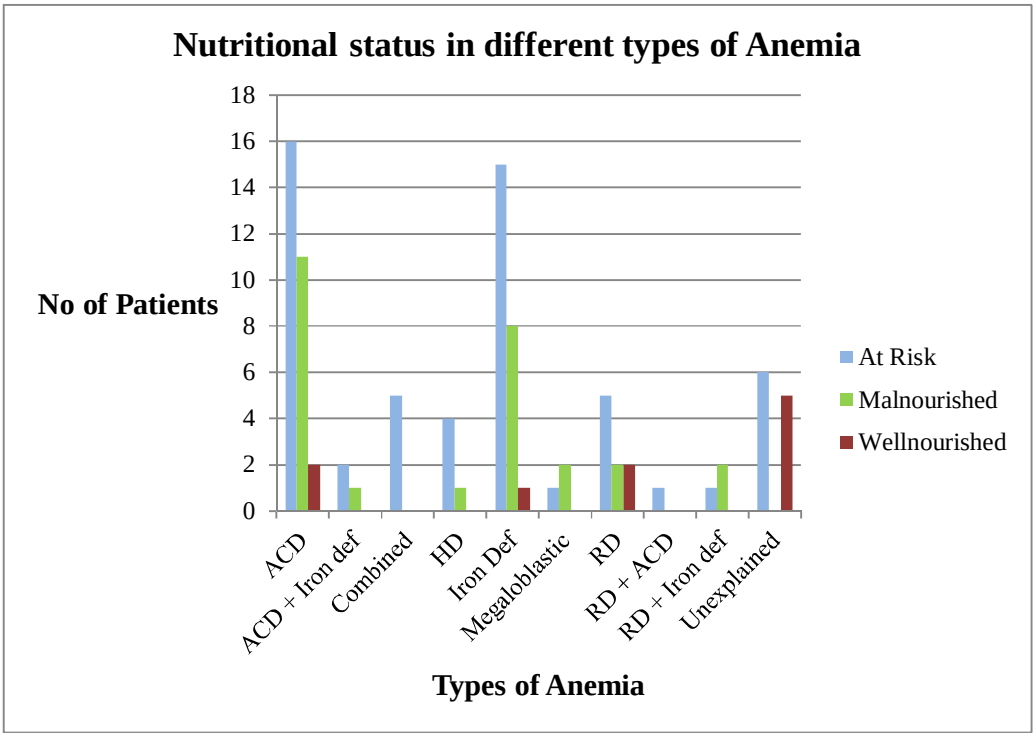
anemia had normal to high serum ferritin levels and needed further investigations.

Distribution of Nutritional status



Using the mini nutritional assessment it is always possible to find out people who are at risk for malnutrition. Number of patients who entered our hospital premises with obvious malnutrition was only 27 people out of 93. MNA helps us to easily pick out cases with increased risk of malnutrition, which in our case were 56 out of 93 patients. Even in healthy individuals, 20% of the elderly are borderline and should be assessed for risk of malnutrition, even if albumin levels and BMI are well within normal range.

These results show that MNA is able to assess nutritional status in the elderly even before severe changes in weight or albumin levels occur. These results show a statistically significant association between malnutrition and presence of anemia and association of low BMI and high prevalence of Anemia. PEM appears to be a strong independent risk factor for 1 year post discharge mortality according to Toulouse-1991.



In all types of anemia the prevalence of subjects at risk for malnutrition were more compared to subject with obvious signs of malnutrition. This highlights the importance of mini-nutritional assessment in detecting elderly people moving towards malnourishment

and the effective ways to tackle the impact of malnutrition on complex physiology of elderly.

In iron deficiency anemia the number of patients well nourished and healthy were more . Only one patient was well nourished in our group.

In ACD , the number of patient who were at risk out numbered the number of patients who are malnourished at the time of admission to the hospital. Even in ACD the number of patients who were well nourished were very less. This could be accounted to the negative protein balance that is very common in chronic diseases .

In Unexplained anemia compared to other groups had significantly large number of well nourished elderly. This highlights the minimal role of nutritional status in unexplained anemia.

DISCUSSION

COMPARATIVE STUDY OF ETIOLOGIES OF ANEMIA IN ELDERLY

ETIOLOGIES	ANDREW et al (in %)	JOOSTEN et al (in %)	NHANES III (in %)	OUR STUDY (in %)
Iron Deficiency	15-23	5-30	20	38
Vitamin B 12	0-15	5-10	14	7
Chronic Kidney Disease	8	-	8	14
Chronic Inflammation	15-35	30-45	20	35
Myelo Dysplastic Syndrome	0-5	5	-	3
Unknown Etiology	17-45	15-25	34	12

In western studies the incidence of iron deficiency was less compared to our study. In our study the incidence is high because of the high prevalence of iron deficiency particularly nutritional deficiency in developing countries. The incidence of Myelodysplastic syndrome was similar to western statistics especially it correlated . The incidence of anemia of unknown etiology was higher in western countries due to the

overlap of many hemopoietic disorders under unknown etiology. The incidence of anemia of renal disease was higher in our study due to poor control of comorbidities like diabetes and hypertension leading to chronic kidney disease.

DETECTION OF MALNUTRITION IN ELDERLY ON ADMISSION TO HOSPITAL

NUTRITIONAL STATUS	MOWE & BAHMER et al	PERSSON MD et al	OUR STUDY
DETECTED MALNOURISHED (<90% OF NORMAL WEIGHT FOR HEIGHT)	55%	56%	60%
RECOGNISED AS MALNOURISHED ON ADMISSION	36%	26%	29%
NUTRITIONALLY STABLE	8%	18%	11%

Our study attempted to correlate the association between the nutritional status and presence of anemia. Nutritional status was assessed by Mini Nutritional Assessment scale which is a very valid tool to assess the nutritional status of ageing population. It has the specificity of 98% and a sensitivity of 96% and a positive predictive value of 97%. These

results showed a statistically significant association between malnutrition and presence of anemia. Further association between low BMI and high prevalence of anemia was also found. This study also shows the usefulness of Mini Nutritional Anemia in assessing the patients at risk for malnutrition. Only 29% of patients were malnourished at the time of admission. About 60% of the patients were detected at risk of malnourishment which was made possible by a valuable tool - MNA

DISTRIBUTION OF MYELO DYSPLASTIC ANEMIA

ETIOLOGY	% OF ANEMIC CASES
MYELODYSPLASIA	3
HEMATOLOGICAL MALIGNANCY	2

In our study hematological malignancies contributed to 5 % of anemia of which the prevalence of MDS was 3% and that of hematological malignancy 2%. The prevalence of MDS was much higher in our study when compared to others.

NUTRITIONAL DEFICIENCY ANAEMIA

NUTRITIONAL ANEMIA	AMIT BASIN & MEDHA RAO et al	JACK & CO WORKERS et al	OUR STUDY
Iron Deficiency	30 %	16.6 %	26%
VIT B12 Deficiency	3%	5.9 %	2%
Folate Deficiency	2 %	6.4 %	1%

Incidence of iron deficiency anemia is maximum in our study which could be attributed to these factors common in our population

1. Insufficient dietary intake
2. Mal-absorption in elderly
3. Chronic bleeding
4. Worm infestations
5. Gastric disorders.

Hence our study corroborates the finding of these studies, Iron deficiency being the most common Nutrition deficient anemia.

ANEMIA OF UNEXPLAINED ETIOLOGY

NHANES III	30%
Beghe et al	14.50 %
Jack & Co Worker et al	33.6 %
Amit Bhasin	2%
Our Study	11.8%

In our study anemia of unexplained etiology is around 11.8 % which is relatively low compared to the western studies. In this disorder anemia is relatively mild is often overlooked .We believe that this disorder is not as mysterious as it is complex. Factors contributing this disorder are

1. Age related decline in renal endocrine function
2. Age related relation in androgen levels
3. Decreased stem cell proliferation
4. Early MDS presenting as anemia without classical features
5. Proinflammatory cytokine dysregulation

Contribution of these factors account for the observed clinical heterogeneity. Our study correlates well with the studies of Beghe et al and Jack & Co Worker et al.

ANEMIA OF CHRONIC DISEASE (ACD)

STUDY	RESULTS
Amit Bhasin et al	48%
NHANES III	30%
Our study	35%

From these studies it is evident that ACD forms the most important cause of anemia in elderly. In Amit Bhasin et al study prevalence of ACD is more followed by Iron deficiency anemia followed by a small proportion of blood loss anemia. In Elejalde Guerra et al study prevalence of Iron deficiency anemia was more than other types of anemia. Our study correlated well with Amit Bhasin et al study. As both were done from the same population.

ANEMIA OF CHRONIC RENAL DISEASE

STUDY	RESULTS
Jack and Co Worker et al	13.2%
Amit Bhasin et al	22%
Our Study	14%

The prevalence of Anemia of chronic renal disease in our study was next only to ACD and Iron Deficiency Anemia.

STUDY ON IRON STORES

STUDY	Sreum Ferritin less than 20 ng/dl
Amit Bhasin et al	**11%**
Milman & Schultz – Larsen	**5.9%**
Our Study	**22%**

Serum Ferritin reflects the total body iron stores. From these results, we can infer that the iron stores are very less in Indian population. And hence they are prone for anemic symptoms as age progresses.

NORMOCYTIC ANEMIA

STUDY	Percentage of Normocytic Anemia in peripheral smear
Amit Bhasin et al	**62%**
Elis et al	**60%**
Amiasal	**62%**
Our study	**41%**

The table above shows that the Normocytic blood picture is the commonest diagnosis in peripheral smear for patients above 65 years of age. Thus, Normocytic blood picture should not be disregarded as a normal peripheral smear picture.

Analytical report

- Prevalence of anemia is more in males in the age group above 65 years.
- Mean age group was 73 years and the maximum number of patients were in the age group of 65-69 years.
- As age increases above 85 yrs prevalence of anemia shooted up dramatically in females.
- Severe anemia is more common in males than females.
- Anemia of chronic disease is the most common anemia followed by iron deficiency anemia.
- Normocytic normochromic anemia and microcytic and hypochromic anemia are the most common peripheral smear pictures in our study.
- Normocytic normochromic study is the commonest peripheral study in ACD.
- MNA was able to identify 56 patients who were at risk for malnutrition.
- Nutritional anemia is the commonest cause for iron deficiency anemia.
- Inflammatory disease were the commonest cause for anemia in chronic disease.

- Normocytic normochromic picture is the commonest peripheral smear picture in both anemia of renal disease and ACD.
- Low serum ferritin store is exclusively seen in iron deficiency anemia.
- Combined deficiency is more common than isolated Vit B 12 or Folate deficiency.
- Anemia of unexplained etiology was very less in our study when compared to western studies .
- Incidence of MDS is 3 % which is very high compared to other studies

CONCLUSION

Our study highlights the fact that most elderly people who are anemic have an underlying cause for anemia. The physician should be aware of the co-existence of anemia with other ailments. It is therefore pertinent to find out the reason for the types of anemia, the possible etiologies and the severity of anemia. Normocytic blood picture in anemic elderly should not be disregarded as it is the commonest blood picture.

Attention should be paid towards the nutrition of the geriatric population as the number of patients who are at risk for malnutrition was very high. Delay in evaluating elder patients for anemia can lead to delayed diagnosis of potentially treatable disease. Non specific complaints like fatigueness and weakness should not be ignored, as these symptoms can be an indication for anemia. Protocol should always be followed to arrive at the etiology of diagnosis before specific treatment is given for the disease.

Primary care providers must be proficient in the initial work-up of the anemic elder. Often, there are multiple medical comorbidities requiring specialist referral. A good working relationship with gastroenterologists and hematologists is important, and nephrology

referral may be indicated for patients with chronic kidney disease. It is up to the primary care clinician to accumulate all pertinent information from specialists and diagnostics and to establish a plan of care that will benefit the patient.

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ANEMIA IN ELDERLY – PROFORMA

Name: Age: Sex:

Address: Occupation:

Duration and details of illness:

History of :

- Malaise / dizziness / giddiness
- Loss of appetite
- Poor food intake
- Dysphagia
- Dyspnoe / breathlessness
- Swelling of legs
- Passing worms in stool
- Malena
- Bone pain
- Prolonged drug intake
- Previous blood transfusions
- Previous Dialysis
- Type of food intake Veg / Non- Veg

Past history:

- Hypertension
- Diabetes
- CAD
- Tuberculosis
- Hypothyroidism
- CKD

DRUG HISTORY:

PERSONAL HISTORY:

☐ Smoking ☐ Alcoholism

GENERAL EXAMINATION:

VITALS

CLINICAL SIGNS

- PALLOR
- GLOSSITIS
- KOILONYCHIA
- PEDAL EDEMA
- LYMPHADENOPATHY
- SPLENOMEGALY / HEPATOMEGALY / HEPATOSPLENOMEGALY
- RAISED JVP

SYSTEMIC EXAMINATION:

CVS:

RS:

ABDOMEN:

CNS:

INVESTIGATIONS:

Hb: TC: DC: P- L- E- M- Plt:
ESR:

PACKED CELL VOLUME :

MCV :

MCH :

MCHC :

RBC COUNT :

RDW :

RETICULOCYTE COUNT :

PERIPHERAL SMEAR :

SERUM FERRITIN :

SERUM LDH :

BLOOD GROUPING :

BLOOD UREA :

SERUM CREATININE :

STOOL OCCULT BLOOD :

MOTION OVA CYST :

BONE MARROW STUDY :

SPECIFIC INVESTIGATIONS FOR SELECTED PATIENTS

SERUM ELECTROPHORESIS :

URINE BJP :

VITAMIN B12 ASSAY :

UPPER G.I. ENDOSCOPY :

URINE EXAMINATION :

Sugar : Deposits:

Albumin :

ECG:

X-RAY CHEST PA VIEW :

USG ABDOMEN :

NUTRITIONAL ASSESSMENT :

MINI NUTRITIONAL ASSESSMENT

Name: **Age:** **Sex:**

Weight kg. **Height cm**

PART I . ANTHROPOMETRIC ASSESSMENT

1.	Body Mass Index(weight in Kg)/(height in m) = a. BMI < 19 = 0 points b. BMI 19 to < 21 = 1 point c. BMI 21 to < 23 = 2 points d. BMI > 23 = 3 points	**Points** _____
2.	Measure of Mid –arm circumference (MAC) in cm. a. MAC < 21 cm. = 0.0 points b. MAC 21 < 22 cm. = 0.5 points c. MAC >22 cm. = 1.0 points	 _____
3.	Measure of Calf circumference (CC) in cm. a. CC < 31 cm = 0 points b. CC > 31 cm =1 point	 _____
4.	Have you had a **weight loss** during the last 3 months a. weight loss greater than 3 kg(6.6 lbs.) = 0 points b. does not know = 1 point c. weight loss between 1 and 3 kg. (2.2 lbs. and 6.6 kg.) = 2 points d. no weight loss = 3 points	 _____

Total points for this section I = _____

PART II. GENERAL ASSESSMENT

1.	**Do you live independently?** (not in Nursing home or Assisted living) a. No = 0 points b. Yes = 1 point	_____
2.	Do you take **more than 3 prescription** drugs per day? a. Yes = 0 points b. No = 1 point	_____
3.	Have you **suffered from Psychological stress** or an **acute illness in the past 3 months?** a. Yes = 0 points b. No = 2 point	_____
4.	**Mobility:** a. You use a wheel chair = 0 points b. You are able to get out of a bed /chair but does not go out alone = 1 point c. You go out independently = 2 points	_____
5.	**Neuropsychological Problems:** a. has severe dementia or depression = 0 points b. mild dementia = 1 point c. no psychological problems = 2 points Mini Mental State Score _____/30	_____
6.	**Skin condition:** Do you have any sores or ulcers (body check) a. Yes = 0 points b. No = 1 point	_____

Total points for this section II = _____

PART III. SELF ASSESSMENT

1.	Do you view yourself as having nutritional problems? a. Yes -major problems with malnutrition = 0 points b. Does not know or has moderate problems = 1 point c. NO –do not have nutrition problems = 2 points	_____
2.	In comparison with other people of the same age, how do you compare your health status? a. Not as good = 0.0 points b. Do not know = 0.5 points c. As good as others = 1.0 points d. Better than most = 2.0 points	_____

Total points for this section III = _____

PART IV DIETARY ASSESSMENT

1.	How many full meals do you eat daily? a. 1 full meal daily = 0 points b. 2 full meals daily = 1 point c. 3 full meals daily = 2 points	_____
2.	Selected consumption markers for protein intake • At least one serving of dairy products (milk, cheese, yogurt) per day? Yes____ No____ • Two or more servings of legumes or eggs per week? Yes___ No ____ • Meat, Fish, or Poultry every day? Yes____ No____ a. If 0 or 1 Yes responses = 0.0 points b. If 2 Yes responses = 0.5 points c. If 3 yes responses = 1.0 points	_____
3.	Do you consume 2 or more servings of fruits or vegetables per day? a. No = 0 points b. Yes = 1 point	_____
4.	Has your food intake declined over the past three months due to loss of appetite, digestive problems, chewing or swallowing problems? a. severe loss of appetite = 0 points b. moderate loss of appetite = 1 point c. no loss of appetite = 2 points	_____
5.	How much fluid (water, juice, tea, milk …)do you consume daily? (1 cup = 8 ounces) a. less than 3 cups = 0.0 points b. 3 to 5 cups = 0.5 points c. More than 5 cups = 1.0 points	_____
6.	Ability to feed self a. requires assistance with meals/feeding = 0 points b. able to feed self, but has some difficulty = 1 point c. able to feed self independently (no problems) = 2 points	_____

Total points for Section IV Dietary Assessment ----------

Section I Anthropometric Assessment Points ----------

Section II General Assessment Points ----------

Section III Self Assessment Points ----------

ASSESSMENT TOTAL POINTS (maximum 30 points))

TOTAL = _____

MALNUTRITION INDICATOR SCORE	
> 24 points	**= Well nourished**
17 to 23.5 points	**= at risk for malnutrition**
< 17 points	**= malnourished**

PATIENT CONSENT FORM

Study Detail	:	"ANEMIA IN AGEING POPULATION - A STUDY OF PREVALENCE & CAUSES "
Study Centre	:	Rajiv Gandhi Government General Hospital, Chennai.
Patient's Name	:	
Patient's Age	:	
Identification Number	:	

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ❑

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ❑

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ❑

d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms. ❑

e) I hereby consent to participate in this study. ❑

f) I hereby give permission to undergo complete clinical examination and hematological ❑

Signature of Investigator

Signature/thumb impression

Study Investigator's Name:

Patient's Name and Address:

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No : 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.D. Priya Malini
PG in MD Geriatrics
Madras Medical College, Chennai -3

Dear Dr.D. Priya Malini

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled " Anemia in ageing population – A study of prevalence & Causes" No.27062012.

The following members of Ethics Committee were present in the meeting held on 19.06.2012 conducted at Madras Medical College, Chennai -3.

1.	Dr. S.K. Rajan. M.D.,FRCP.,DSc	-- Chairperson
2.	Prof. K. Ramadevi MD Prof of Biochemistry, MMC, Ch-3	-- Member
3.	Prof. R. Nandhini MD Director, Inst. of Pharmacology ,MMC, Ch-3	-- Member
4.	Prof. C. Rajendiran, MD Director , Inst. of Internal Medicine, MMC, Ch-3	-- Member
5.	Prof. S. Deivanayagam MS Prof of Surgery, MMC, Ch-3	-- Member
6.	Prof. A. Radhakrishnan MD Prof of Internal Medicine, MMC, Ch-3	-- Member

We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

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E-mail	dr_priyamalini@yahoo.co.in
Submission time	25-Dec-2012 01:42AM
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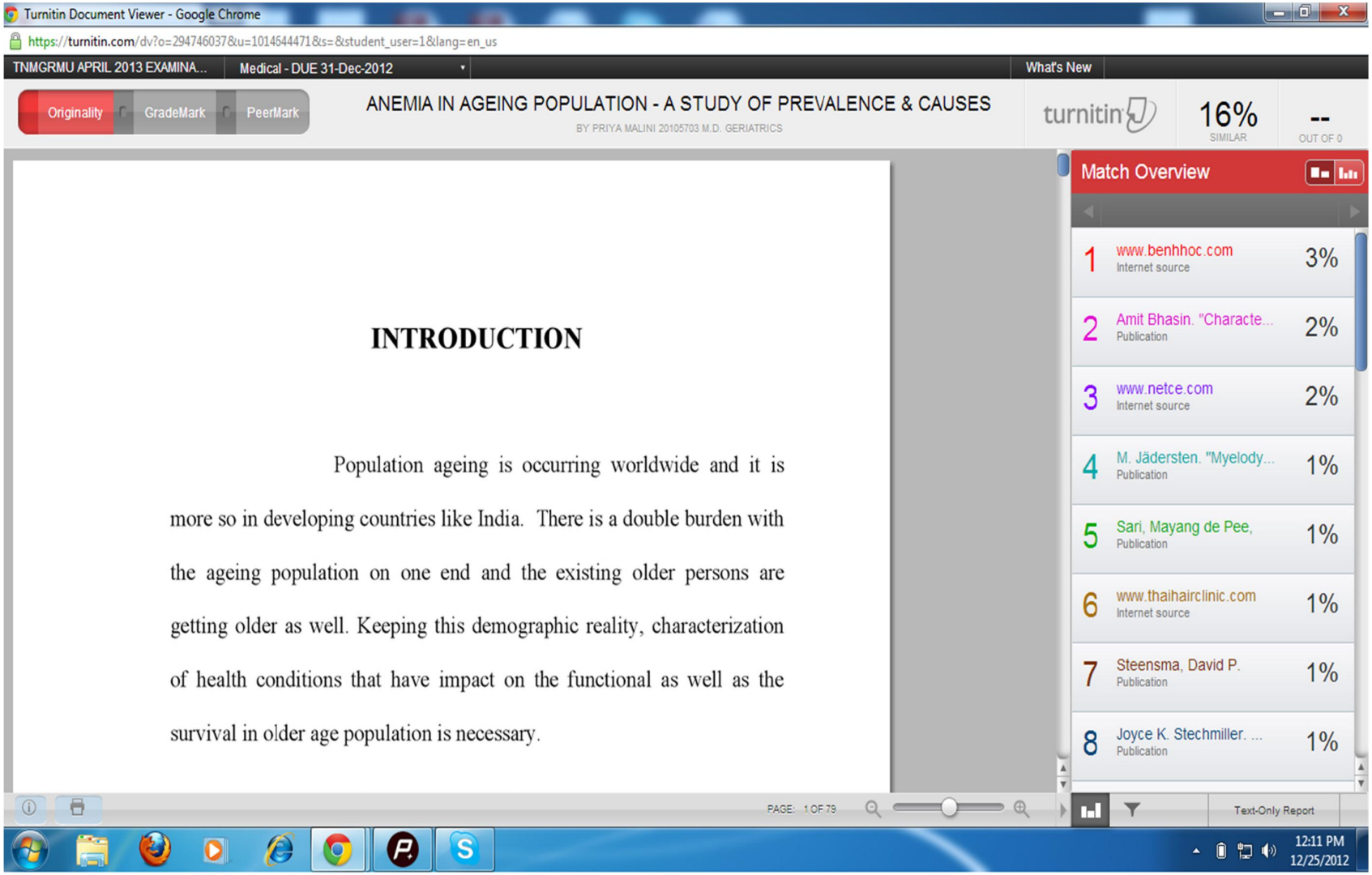
First 100 words of your submission

INTRODUCTION Population ageing is occurring worldwide and it is more so in developing countries like India. There is a double burden with the ageing population on one end and the existing older persons are getting older as well. Keeping this demographic reality, characterization of health conditions that have impact on the functional as well as the survival in older age population is necessary. Anemia is one of the commonest disease that has adverse outcome in older population including hospitalisation, disability and mortality. Since anemia is a multi-factorial condition, it is difficult to establish whether anemia is a marker of disease burden or a mediator in casual pathway leading to...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INTRODUCTION
Population ageing is occurring worldwide and it is more so in developing countries like India. There is a double burden with the ageing population on one end and the existing older persons are getting older as well. Keeping this demographic reality, characterization of health conditions that have impact on the functional as well as the survival in older age population is necessary.
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Text-Only Report
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Pt. No		1	2	3	4	5	6	7	8
Age		65	70	70	76	72	70	67	80
Sex		M	F	F	M	F	F	M	F
Hb (gm/dl)		7.8	8.8	5.0	6.0	8.3	9.0	8.0	6.4
TC		5200	7000	4600	10600	10200	11400	2200	6800
ESR		20/45	20/40	30/65	15/45	15/35	30/78	30/65	15/30
Platelet Count (in Lakhs)		0.56	2.20	1.00	1.00	1.86	1.80	0.20	1.90
PCV		24	26	19	18	30	26	24	26
MCV		105.2	73.4	74.5	86.3	92	92	84	78
MCH		33.9	30.1	32	31.4	28.9	31.4	30.4	30.1
RBC Count(in Lakhs)		2.3	2.1	2.4	2.4	3.77	2.8	3	2.9
Recticulocite Count		0.86	1	1	1.2	0.9	1	0.5	1.2
Sr. LDH		2697	165	110	174	182	314	870	157
Sr. Ferritin		34	34	44	88	94	78	72	14
Sr. Electrophoresis		Normal	-	Normal	-	-	Normal	Normal	-
Blood Urea		28	34	32	29	35	32	24	18
Sr Creatine		0.9	1.2	1.1	0.9	1.1	1.2	0.8	0.7
Peripheral Smear	**RBC**	Micro Macro Hypo	Micro Hypo	Microcytosis Macrocytosis Polychromatophilic	Normo Normo	Normo Normo	Normo Normo	Microcytosis Macrocytosis Polychromatophilic	Micro Hypo
	WBC	Normal	Normal	Normal	Normal	Increased	Increased	Leucocytosis	Normal
	Platelets	Decreased	Adequate	Decreased	Adequate	Clumps+	Adequate	Decreased	Adequate
	Abnormal Cells	-	-	Target Cells/ Gaint Cells/ HSP +ve	-	-	-	Transformed Monocytoid Cells with Megaloblastoid changes	-
Bone Marrow		Hypocellular	Hypocellular	Megakarocytes, Hypocellular Dysplastic Nuclei, Dymorphyic	-	-	Normal	Hypercellular Dysplastic Nuclei Megakarocytosis	-
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
LGI scopy		-	-	-	-	-	-	-	-
Others		DCT - Neg	Hemorrhoids	-	-	-	-	DCT - Neg	-
MNA score		11.5	17.5	21.5	21	20.5	21	17.5	20
Nutritional Status		Malnourished	At Risk	At Risk	At Risk	At Risk	At Risk	At Risk	At Risk
Ailments		Hemolytic	Blood Loss	MDS	Pneumonia	Lung Abcess	PT Sequalae	MDS	Nutritional
Type of Anemia		ACD	Iron Deficiency	HD	ACD	ACD	ACD	HD	Iron Deficiency

Pt. No		9	10	11	12	13	14	15	16
Age		71	70	71	70	75	65	75	76
Sex		F	F	M	F	F	M	F	F
Hb (gm/dl)		7.8	9.8	9.5	5.6	9.6	7.3	10.6	10.3
TC		8000	7800	9100	7000	6500	11000	7200	6900
ESR		22/45	13/25	45	20/40	60	52	16	20
Platelet Count (in Lakhs)		1.00	4.80	2.54	2.90	1.74	2.50	1.15	1.80
PCV		27	29	30	19	21	26	30	33
MCV		80	79.4	88	76	85	72	88	90
MCH		31.4	30.4	33.9	30	31.4	30.8	31.4	32
RBC Count(in Lakhs)		2.8	3.1	3.12	3.2	2.89	3	2.69	3.14
Recticulocite Count		0.5	1.5	1.5	1	1.2	1	1.6	0.2
Sr. LDH		167	143	399	144	168	202	419	347
Sr. Ferritin		13	48	45	10	64	18	104	214
Sr. Electrophoresis		-	-	-	-	-	-	-	-
Blood Urea		20	24	26	28	30	29	26	26
Sr Creatine		0.6	0.9	1	0.9	0.9	0.9	0.9	1
Peripheral Smear	**RBC**	Micro Hypo	Micro Hypo	Normo Normo Micro	Micro Hypo	Micro Macro Hypo	Micro Hypo	Normo Normo	Normo Normo
	WBC	Normal	Normal	Normal	Normal	Normal	Increased	Normal	Normal
	Platelets	Adequate	Increased	Adequate	Increased	Adequate	Adequate	Adequate	Adequate
	Abnormal Cells	Few atypical Lymphocytes	Clumps+, HSP +ve	-	Poikilocytosis	-	-	-	-
Bone Marrow		Normal	Normal	Hypocellular	Hypocellular	Dimorphic	-	M : E = 4:1 Sideroblast Decreased, Increased Macrophage Iron	-
Stool Occult Blood		Pos	Neg	Neg	Neg	Neg	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Bulbar Duodenitis	Normal	Normal	Normal	Normal	Antral Ulcer	Normal	-
LGI scopy		-	-	-	-	-	-	-	-
Others		-	Sr. Fe / 110 µg/dl	-	-	Vit B12 - 120 Pg/dl Sr.Fe 40 µg/dl	Sr. Fe 34 µg/dl	RA +ve	-
MNA score		18	19	20	11	18	20	14.5	15.5
Nutritional Status		At Risk	At Risk	At Risk	Malnourished	At Risk	At Risk	Malnourished	Malnourished
Ailments		Blood Loss	-	Rh -Arthritis	Nutritional	Nutritional	Blood Loss	Rh - Arthritis	OA
Type of Anemia		Iron Deficiency	Unexplained	ACD + Iron def	Iron Deficiency	Combined	Iron Deficiency	ACD	ACD

Pt. No		17	18	19	20	21	22	23
Age		65	67	65	76	65	72	80
Sex		F	M	M	F	M	F	F
Hb (gm/dl)		8.4	6.0	11.0	8.5	3.0	4.3	8.0
TC		7200	5800	4600	5400	3400	7500	5800
ESR		45	31	18	46	120	80	42
Platelet Count (in Lakhs)		1.60	2.10	1.12	1.40	0.62	1.90	1.74
PCV		27	30	35	30	10	16	25
MCV		86	102	89	74	70	68	80
MCH		31.4	32.8	31.8	32	28.6	27.4	30.4
RBC Count(in Lakhs)		3.1	2.99	3.2	3.1	1.9	1.76	2.4
Recticulocite Count		0.6	0.8	0.9	0.8	1.5	1.2	0.5
Sr. LDH		456	164	212	208	2380	168	180
Sr. Ferritin		94	188	124	15	455	10	12
Sr. Electrophoresis		-	-	-	-	Normal	-	-
Blood Urea		98	26	70	20	24	30	18
Sr Creatine		5.5	9	2.6	0.9	0.8	1	0.7
Peripheral Smear	**RBC**	Normo Normo Micro	Normo Normo Macro	Micro Hypo	Micro Hypo	Micro Hypo	Micro Hypo	Micro Hypo
	WBC	Normal	Normal	Normal	Normal	Decreased	Normal	Normal
	Platelets	Adequate	Adequate	Adequate	Adequate	Decreased	Adequate	Adequate
	Abnormal Cells	-	Macrocytosis+ Hypercellular, increased erythrocytogenesis	-	-	Anisocytosis, Poikilocytosis Megakarocytes+, Nucleated RBCs, No Blast	Target Cells	-
Bone Marrow		-		-	-		Hypocellular	-
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Pos	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Varices	Uremic Gastritis	Normal	Normal	Duodenal Ulcer	Antral Ulcer
LGI scopy		-	-	-	-	-	-	-
Others		Sr.Fe 56 µg/dl	-	-	Sr. Fe 32 µg/dl	-	Sr. Fe 12 µg/dl	Sr. Fe 44µg/dl
MNA score		16.5	19	14	19	15.5	16.5	17.5
Nutritional Status		Malnourished	Malnourished	Malnourished	At Risk	Malnourished	Malnourished	At Risk
Ailments		CKD	DCLD	CKD	Nutritional	Lung Malignancy	Blood Loss	Drug Intake
Type of Anemia		Renal Disease + Iron def	ACD	Renal Disease	Iron Deficiency	ACD	Iron Deficiency	Iron Deficiency

Pt. No		24	25	26	27	28	29	30
Age		66	71	77	67	72	75	66
Sex		F	M	M	M	M	F	F
Hb (gm/dl)		8.4	8.8	9.8	4.0	11.8	7.6	7.6
TC		25000	6000	10200	5200	11600	5500	8600
ESR		24/56	44	40	45/95	10	57	16
Platelet Count (in Lakhs)		0.25	1.30	1.38	1.36	2.40	1.60	2.10
PCV		32	26	25	16	34	27	22
MCV		101.7	92	94	59.9	88	68	78
MCH		31.4	31.8	31.9	24.5	32.2	33	32.8
RBC Count(in Lakhs)		2.41	2.6	3.1	2.72	3.24	2.8	2.6
Recticulocite Count		0.2	1	0.9	0.6	0.8	0.9	1.5
Sr. LDH		138	940	186	154	309	252	503
Sr. Ferritin		78	88	63	10	143	9	112
Sr. Electrophoresis		Normal	-	-	-	-	-	-
Blood Urea		24	30	76	24	36	32	31
Sr Creatine		0.8	0.9	2	0.9	1.1	1.2	1
Peripheral Smear	**RBC**	Normo Normo	Micro Hypo	Normo Normo	Micro Hypo	Normo Normo	Micro Hypo	Normo Normo Micro
	WBC	Increased	Normal	Normal	Normal	Increased	Normal	Normal
	Platelets	Decreased	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
	Abnormal Cells	Blast Cells+	-	-	Anisocytosis, Poikilocytosis	-	-	-
Bone Marrow		ALL in remission	Normal	-	Hypocellular	-	-	Normal
Stool Occult Blood		Neg	Neg	Neg	Pos	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	-	Normal	Normal
LGI scopy		-	-	-	Colon Polyt	-	-	-
Others		-	-	-	Sr. Fe 44 µg/dl	-	Sr Fe 55 µg/dl	Sr Fe 124 µg/dl
MNA score		19	24.5	23	16.5	24	18.5	22
Nutritional Status		At Risk	Wellnourished	At Risk	Malnourished	Wellnourished	At Risk	At Risk
Ailments		ALL	Post MI	CKD	Blood Loss	Pneumonia	Nutritional	-
Type of Anemia		HD	Unexplained	Renal Disease	Iron Deficiency	ACD	Iron Deficiency	Unexplained

Pt. No		31	32	33	34	35	36	37	38	39
Age		71	75	65	72	66	66	67	73	78
Sex		F	M	M	F	M	F	M	F	F
Hb (gm/dl)		10.6	6.5	10.6	9.9	9.8	9.2	12.4	11.2	9.9
TC		14800	6500	4800	5300	6100	6400	7000	9400	5300
ESR		30	64	28	30	40	20/40	13	58	30
Platelet Count (in Lakhs)		1.55	1.80	1.75	2.76	1.00	2.40	1.80	1.80	2.76
PCV		31	21	30	30	30	30	38	34	34.7
MCV		86	88	90	85	88	78	84	80	90
MCH		31.4	32	33	32.8	31.4	31.6	33	34	33
RBC Count(in Lakhs)		3	1.96	3.12	2.96	3.8	2.9	3.5	3.14	3
Recticulocite Count		0.5	1.2	2	1.5	1	0.2	2	0.8	1.4
Sr. LDH		436	188	162	342	176	190	493	227	156
Sr. Ferritin		256	88	84	143	106	12	68	46	94
Sr. Electrophoresis		-	-	-	-	-	-	-	-	-
Blood Urea		36	36	58	18	74	28	26	18	22
Sr Creatine		1.2	1.2	2.9	0.8	2.2	0.8	0.9	0.7	0.9
Peripheral Smear	**RBC**	Normo Normo	Normo Normo	Normo Normo Micro	Normo Normo	Normo Normo	Micro Hypo	Normo Normo	Micro Hypo	Normo Normo
	WBC	Increased	Normal	Normal	Normal	Normal	Normal	Normal	Increased	Normal
	Platelets	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
	Abnormal Cells	-	-	-	-	-	Clumps+	-	-	-
Bone Marrow		-	Normal	-	Normal	-	-	Normal	-	Normal
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Pos	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
LGI scopy		-	-	-	-	-	Colon Polyt	-	-	-
Others		-	Sr Fe 164 µg/dl	Sr.Fe 60µg/dl	-	-	Sr Fe 38 µg/dl	Sr Fe 120 µg/dl	Sr Fe 94µg/dl	-
MNA score		16	20.5	15.5	16	25	16.5	24.5	23	24
Nutritional Status		Malnourished	At Risk	Malnourished	Malnourished	Wellnourished	Malnourished	Wellnourished	At Risk	Wellnourished
Ailments		Emphyema	-	CKD	Thyroid Malignancy	CKD	Blood Loss	AWMI	Pneumonia	-
Type of Anemia		ACD	Unexplained	Renal Disease + Iron def	ACD	Renal Disease	Iron Deficiency	Unexplained	ACD	Unexplained

Pt. No		40	41	42	43	44	45	46	47	48	49	50
Age		73	68	70	66	65	68	69	76	82	67	68
Sex		M	M	M	M	F	F	M	M	F	F	M
Hb (gm/dl)		11.4	10.6	8.4	11.0	4.4	8.4	10.0	10.2	8.6	8.5	10.6
TC		6800	7300	9200	8000	2500	6300	6000	6800	4000	5400	4800
ESR		22	36	36	45	24	54	8	30	55	46	28
Platelet Count (in Lakhs)		4.32	2.10	1.50	1.38	1.10	1.85	1.92	1.72	1.20	1.40	1.75
PCV		34	32	26	33	18	30	39	30	35	25	30
MCV		92	94	96	94	58	84	78	74	70	68	88
MCH		34	33	32	34	28.4	32.3	34	29.4	28.4	27.9	32.4
RBC Count(in Lakhs)		3.24	3	3	3.14	1.44	2.1	3.24	2.9	2.1	2.24	3.2
Recticulocite Count		1.2	1	1.8	1	0.9	0.5	1.2	0.5	1.2	1.2	2
Sr. LDH		247	885	202	460	339	193	183	395	277	473	162
Sr. Ferritin		20	98	106	198	578	96	76	12	10	16	86
Sr. Electrophoresis		-	-	-	-	-	-	-	-	-	-	-
Blood Urea		28	48	45	32	29	27	26	27	36	34	28
Sr Creatine		0.9	1.8	1.1	1	1	1.1	0.9	1	1.1	1	1
Peripheral Smear	**RBC**	Normo Normo	Normo Normo	Normo Normo	Normo Normo	Micro Hypo	Normo Normo	Normo Normo Micro	Micro Hypo	Micro Hypo	Micro Hypo	Normo Normo
	WBC	Normal	Normal	Normal	-	Decreased	Normal	Normal	Normal	Normal	Normal	Normal
	Platelets	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
	Abnormal Cells	-	-	-	Lymphocytes 10%	-	-	-	-	Poikilocytosis	-	-
Bone Marrow		-	-	Normal	Atypical cells - 20%	Hypocellular	-	Normal	-	-	-	-
Stool Occult Blood		Pos	Neg	Neg	Neg	Pos	Neg	Neg	Neg	Neg	Pos	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	Antral Gastritis	Normal	Normal	Normal	Normal	Normal	-
LGI scopy		-	-	-	-	-	-	-	-	-	-	-
Others		Hemorrhoids	-	Sr Fe 134µg/dl	-	Sr.Fe 40µg/dl	-	Sr.Fe 140µg/dl	Sr Fe 52µg/dl	Sr Fe 62µg/dl	Hemorrhoids	Sr Fe98µg/dl
MNA score		22	22.5	20.5	23	15.5	19.5	22.5	23	19.5	16.5	23
Nutritional Status		At Risk	At Risk	At Risk	At Risk	Malnourished	At Risk	At Risk	At Risk	At Risk	Malnourished	At Risk
Ailments		Blood Loss	CKD	-	.ung Malignanc	GI Malignancy	LORA	-	Nutritional	Nutritional	Blood Loss	CVA
Type of Anemia		Iron Deficiency	Renal Disease	Unexplained	ACD	ACD + Iron def	ACD	Unexplained	Iron Deficiency	Iron Deficiency	Iron Deficiency	ACD

Pt. No		51	52	53	54	55	56	57	58	59	60	61
Age		66	77	65	80	70	67	75	66	65	78	69
Sex		F	F	M	F	M	M	M	M	F	M	M
Hb (gm/dl)		10.3	7.0	11.4	8.6	7.0	10.0	12.0	6.9	8.6	9.8	6.5
TC		8100	4200	6800	4000	8000	4400	6100	8100	7800	6500	7400
ESR		14	65	40	55	56	26	18	58	25	45	18
Platelet Count (in Lakhs)		1.18	1.80	2.10	1.20	2.15	1.66	2.18	1.60	1.80	2.10	1.84
PCV		32	21	39	25	21	30	36	20	28	30	19
MCV		72	88	92	88	80	74	96	78	90	89	90
MCH		33	28.4	34	32.2	33.5	32.6	33.8	33	34	32.4	33.8
RBC Count(in Lakhs)		3.1	2.89	3.89	3	3.1	2.9	3.2	2.24	2.14	3.1	2.64
Recticulocite Count		1	0.5	1.9	1.6	0.8	0.5	0.8	0.8	0.5	0.9	0.2
Sr. LDH		205	298	364	277	659	362	90	167	193	354	110
Sr. Ferritin		14	58	36	96	76	18	24	43	88	44.6	72
Sr. Electrophoresis		-	-	-	-	-	-	B band	-	-	-	-
Blood Urea		32	66	28	36	173	38	28	110	58	33	28
Sr Creatine		1	2.1	0.9	1.1	4	1.2	1.2	5.8	1.8	0.8	0.8
Peripheral Smear	**RBC**	Micro Hypo	Normo Normo	Normo Normo	Normo Normo	Micro Hypo	Micro Hypo	Micro Macro Hypo	Normo Normo Micro	Normo Normo	Normo Normo	Normo Normo
	WBC	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
	Platelets	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate
	Abnormal Cells	Anisocytosis, Poikilocytosis	-	-	-	Burr Cells	-	-	Burr Cells	-	-	-
Bone Marrow		Hypocellular	Normal	Normal	Normal	Hypocellular	-	Dimorphic	Hypocellular	-	-	-
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	Antral Gastritis	Normal	Normal	Normal	Normal	Normal	Normal
LGI scopy		-	-	-	-	-	-	-	-	-	-	-
Others		Sr Fe 28µg/dl	-	Sr Fe144µg/dl	Sr Fe 123µg/dl	Sr.Fe114µg/dl	Sr Fe52µg/dl	Vit B12 160 Sr Fe 40µg/dl	Sr.Fe 60µg/dl	-	Sr Fe54µg/dl	-
MNA score		16.5	21.5	25	22.5	16.5	23	20.5	17.5	25.5	22.5	22
Nutritional Status		Malnourished	At Risk	Wellnourished	At Risk	Malnourished	At Risk	At Risk	At Risk	Wellnourished		At Risk
Ailments		Nutritional	CKD	-	-	CKD	Nutritional	Nutritional	CKD	CKD	.ung Malignanc	OA
Type of Anemia		Iron Deficiency	Renal Disease	Unexplained	Unexplained	Renal Disease	Iron Deficiency	Combined	al Disease + Iror	Renal Disease	ACD + Iron def	ACD

Pt. No		62	63	64	65	66	67	68	69	70	71	72
Age		68	68	66	68	70	65	72	70	71	69	67
Sex		F	F	M	M	M	M	F	M	M	M	F
Hb (gm/dl)		3.0	9.0	6.5	9.8	7.0	8.2	9.1	7.6	8.1	8.8	9.8
TC		3000	6800	5400	6600	11400	9400	7400	8400	9800	3400	40000
ESR		90	58	28	84	90	114	38	34	74	36	102
Platelet Count (in Lakhs)		2.80	1.90	1.98	1.94	1.90	1.80	2.00	1.69	1.60	0.86	0.98
PCV		9	29	22	30	26	28	28	21	24	29	20
MCV		57	76	94	86	86	84	88	76	85	108	32
MCH		25.6	32.8	34.2	32.4	33	32	33.4	32	33	34	30
RBC Count(in Lakhs)		1.6	2.24	1.64	1.98	2.01	2.1	2.14	1.84	1.96	1.8	1.4
Recticulocite Count		0.05	1.2	0.8	2	0.8	1	1	0.6	0.8	1	0.5
Sr. LDH		174	184	194	146	214	179	236	196	166	188	649
Sr. Ferritin		10	106	22	39	72	162	173	16	83	42	344
Sr. Electrophoresis		-	-	-	-	-	-	-	-	-	-	-
Blood Urea		28	32	34	26	31	26	28	32	32	32	24
Sr Creatine		1	0.8	0.8	0.8	0.9	0.7	1	1	0.9	0.8	1.1
Peripheral Smear	**RBC**	Micro Hypo	Micro Hypo	Micro Macro Hypo	Normo Normo	Normo Normo	Normo Normo	Normo Normo	Micro Hypo	Normo Normo	Macro Hypo	Normo Normo
	WBC	Decreased	Normal	Normal	Normal	Increased	Normal	Normal	Normal	Increased	Decreased	Increased
	Platelets	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Decreased	Decreased
	Abnormal Cells	-	-	-	-	-	-	-	Poikilocytosis	-	Spur Cells	Blast 10% Smear Cells
Bone Marrow		Hypocellular, No Blast	-	Dymorphic	Normal	-	-	-	Hypocellular	-	Megakaryocytes increase cellularity	Hypoceellular, > 30 % blast
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Post GJ Gastritis	Normal	Normal	Normal	Normal	Normal	Normal	Varices	Normal
LGI scopy		Normal	-	-	-	-	-	-	-	-	-	-
Others		-	-	Vit B12 150 Sr Fe 38µg/dl	Sr Fe 132µg/dl	-	-	Sr Fe 104µg/dl	Sr Fe 55µg/dl	-		-
MNA score		14	16	19.5	25.5	19.5	20	22.5	24.5	23	14.5	21
Nutritional Status		Malnourished	Malnourished	At Risk	Wellnourished	At Risk	At Risk	At Risk	Wellnourished	At Risk	Malnourished	At Risk
Ailments		Nutritional	PT Sequalae	Post GJ	-	Pneumonia	LORA	PT Sequalae	Nutritional	Pneumonia	DCLD	CLL
Type of Anemia		Iron Deficiency	ACD	Combined	Unexplained	ACD	ACD	ACD	Iron Deficiency	ACD	ACD	HD

Pt. No		73	74	75	76	77	78	79	80	81	82	83
Age		68	65	70	65	72	70	70	65	69	68	69
Sex		M	F	M	F	M	M	M	M	M	M	M
Hb (gm/dl)		7.1	4.1	7.4	8.8	8.0	9.0	8.8	7.1	8.5	4.6	6.0
TC		4000	2400	7600	8400	7400	6200	5800	6200	7200	4600	4800
ESR		45	66	46	84	76	70	56	18	14	70	28/60
Platelet Count (in Lakhs)		0.96	0.24	1.60	1.80	1.90	1.40	1.80	1.90	1.50	1.80	1.20
PCV		22	24	22	24	26	30	28	21	22	19	21
MCV		114	64	90	94	78	85	86	76	78	70	74
MCH		35	32	34	36	33.1	34	32	30	30	28	30
RBC Count(in Lakhs)		3.4	2.8	3.5	3	3.2	3	2.8	3.4	3.1	2.4	2.8
Recticulocite Count		1.2	0.2	0.8	1	0.8	1	0.9	0.8	1	0.2	0.9
Sr. LDH		340	176	198	204	266	146	210	179	208	266	148
Sr. Ferritin		72	452	110	124	49	166	89	16	12	10	94
Sr. Electrophoresis		-	Normal	-	-	-	Normal	-	-	-	-	-
Blood Urea		38	32	98	74	24	24	30	28	29	30	32
Sr Creatine		0.8	0.9	4.4	2.3	0.8	0.8	1	0.8	0.9	1.1	1
Peripheral Smear	**RBC**	Macro Hypo	Micro Hypo	Normo Normo	Normo Normo	Micro Hypo	Normo Normo	Normo Normo	Micro Hypo	Micro Hypo	Micro Hypo	Micro Hypo
	WBC	Normal	Decreased	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
	Platelets	Adequate	Decreased	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Decreased
	Abnormal Cells	-	-	Burr Cells	-	-	-	-	-	Poikilocytosis	Poikilocytosis	Cells,Gaint Cells
Bone Marrow		megakaryopoiesis	Hypocellular	-	-	-	-	-	Hypocellular	Hypocellular	Hypocellular	Hypercellular, Megakaryocytosis
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Pos	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	Normal	Normal	Normal	Peptic Ulcer	Normal	Hookworms	Normal
LGI scopy		-	-	-	-	-	-	-	-	-	-	-
Others		vitb12_110	-	-	Sr.Fe 102µg/dl	-	-	-	Sr Fe 48µg/dl	-	Sr Fe 32µg/dl	-
MNA score		16.5	16	18.5	20	19.5	22.5	24.5	21.5	20	16.5	15.5
Nutritional Status		Malnourished	Malnourished	At Risk	At Risk	At Risk	At Risk	Wellnourished	At Risk	At Risk	Malnourished	Malnourished
Ailments		B12 Deficiency	GI Malignancy	CKD	CKD	Rh - Arthritis	OA	Hypothyroid	Blood Loss	Colorectal CA	Blood Loss	MDS
Type of Anemia		Megaloblastic	ACD	Renal Disease	nal Disease + A	ACD	ACD	ACD	Iron Deficiency	Iron Deficiency	Iron Deficiency	HD

Pt. No		84	85	86	87	88	89	90	91	92	93
Age		78	66	70	65	68	71	66	65	81	76
Sex		M	M	M	M	M	M	M	M	F	M
Hb (gm/dl)		8.2	9.0	8.9	5.6	10.6	9.7	9.7	8.7	8.4	8.8
TC		5400	6200	7200	4600	10300	6800	4700	27300	7200	6400
ESR		16	26	38	88	32	33	42	32	34	46
Platelet Count (in Lakhs)		1.00	1.80	1.90	1.80	1.90	1.80	1.00	1.80	1.90	1.90
PCV		30	28	30	32	21	24	26	28	21	30
MCV		116	80	86	84	84	78	86	114	74	104
MCH		34	30	32	32	33	32	32	34	30	34
RBC Count(in Lakhs)		3	3	2.94	2.6	3.4	3	3.6	3.1	2.86	3.1
Recticulocite Count		1	1	0.8	0.5	1	0.9	1	0.8	1	0.8
Sr. LDH		194	164	198	188	144	156	44	281	186	164
Sr. Ferritin		77	104	56	890	56	12	168	76	18	28
Sr. Electrophoresis		-	-	-	-	-	-	-	-	-	-
Blood Urea		26	88	28	30	34	28	20	26	18	22
Sr Creatine		1	4.5	1	1.2	1	1	0.7	0.9	0.7	0.8
Peripheral Smear	**RBC**	Macro Hypo	Micro Hypo	Micro Macro Hypo	Normo Normo	Micro Macro Hypo	Micro Hypo	Normo Normo	Normo Normo Macro	Micro Hypo	Macro Hypo
	WBC	Normal	Normal	Normal	Normal	Increased	Normal	Normal	Increased	Normal	Normal
	Platelets	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Decreased	Adequate	Adequate	Adequate
	Abnormal Cells	ted Neutrophils	Burr Cells	ted Neutrophils	-	-	-	-	-	-	-
Bone Marrow		Erythyroid Hypertlasia	-	-	-	hypercellular	hypocellular	-	Hypercellular	-	-
Stool Occult Blood		Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
Motion Ova Cyst		Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
UGI scopy		Normal	Normal	Normal	Normal	Post GJ Gastritis	Normal	Normal	Normal	Normal	Normal
LGI scopy		-	-	-	-	Normal	-	-	-	-	-
Others		Folate 2ng/ml	-	Sr Fe 36µg/dl, B12 134	-	Sr Fe 40µg/dl B12 158	Sr Fe 26µg/dl	-	-	Sr Fe 36µg/dl	B12 124
MNA score		16.5	22.5	21.5	16	18	17.5	21	22.5	18.5	22
Nutritional Status		Malnourished	At Risk	At Risk	Malnourished	At Risk	At Risk	At Risk	At Risk	At Risk	At Risk
Ailments		olate Deficienc	CKD	Nutritional	Abd. TB	Post GJ	Nutritional	PT Sequalae	DCLD	Nutritional	B12 Deficiency
Type of Anemia		Megaloblastic	Renal Disease	Combined	ACD	Combined	Iron Deficiency	ACD	ACD	Iron Deficiency	Megaloblastic

ABBREVATIONS

Hb :	Hemoglobin
WHO :	World Health Organization
NHANES III :	National Health and Nutrition Examination Survey
RBC :	Red Blood Cell
MCV :	Mean Corpuscular Volume
MCH :	Mean Corpuscular Hemoglobin
EPO :	Erythropoietin
MDS :	Myelodysplastic Syndrome
MNA :	Mini Nutritional Assessment
PEM :	Protein Energy Malnutrition
CKD :	Chronic Kidney Disease
RD :	Renal Disease
ACD :	Anemia of Chronic Diseases
MMSE :	Mini Mental Status Examination
AML :	Acute Myeloid Leukemia
UGI :	Upper Gastrointestinal